

CLINICAL AND RADIOGRAPHIC EVALUATION OF DIRECT PULP CAPPING PROCEDURES PERFORMED BY POSTGRADUATE STUDENTS

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Abstract

Aim of study. To evaluate the outcome of direct pulp capping procedures in permanent teeth performed by postgraduate students during their training program in Endodontics. **Material and Methods.** 39 patients with dental pulp exposures were evaluated clinically and radiologically after direct pulp capping procedure and followed for at least 24 months. The results were considered successful if the tooth remained vital, with neither symptoms nor periapical radiolucency. **Results.** The success rate of direct pulp capping was 59.3%, associated more with traumatic exposure than with carious exposure (75% versus 29.03%, $p < 0,001$) and more with class I occlusal restorations (85.71%) than with proximal restorations (class II 59.09%, class III 66.67%, $p = 0,009$). **Conclusions.** The choice of direct pulp capping procedures in caries lesions or traumatic exposure must be supported by a correct diagnosis, evaluation of pain history, symptoms and radiographic examination. The best results are noted in young patients with recent traumatic exposures.

Keywords: Pulp capping, accidental pulp exposure, clinical outcome

Introduction

The exposure of dental pulp occurs during dental therapy of deep carious lesions or after trauma and as a rule, the pulp is inflamed in both instances. This clinical situation is characterized by the presence of bacterial contamination and the dentist may choose between vital pulp therapy or endodontic methods. Even today, the subject of vital pulp therapy remains controversial, especially regarding the pulp dressing material that offers the

most predictable healing (Mente et al 2010, Al-Hezami et al 2011, Shi et al 2015).

Various methods have been proposed for the treatment of traumatic and caries exposed dental pulps in mature permanent teeth, but many have been based only on clinical experience and their outcomes were not always scientifically validated (Hilton 2009). The most common direct pulp capping agent was calcium hydroxide, which is antibacterial and disinfects the superficial pulp. During the last decade, Mineral Trioxide Aggregate (MTA) was used in a series of investigations and proved to be biocompatible and to protect against microleakage (Mente et al, 2010). Several studies have reported that MTA induces pulpal cell proliferation, cytokine release, hard tissue formation and synthesis of an interface with dentin that resembles hydroxyapatite (Mente et al 2010, Shi et al 2015).

The purpose of this study is to describe the outcome of direct pulp capping procedures obtained by postgraduate students during their teaching program in Endodontics in using MTA and glass ionomer cement for the treatment of dental pulp exposure.

Material and methods

We evaluated a consecutive series of 39 patients with a mean age of 21.5 years (10.8-30.2 years) referred to our clinic for dental treatment, in which pulp exposure occurred during conservative treatment of dental caries or after traumatic injuries. In 31 cases the teeth had initial deep carious lesions and in 8 cases there were traumatic exposures of dental pulp. As inclusion criteria we used: clinically and radiologically diagnosed dental caries in permanent teeth without any periapical pathology, teeth with accidental pulp exposure, asymptomatic (with no clinical signs of pulpitis) and as exclusion criteria: teeth revealing clinical pulp exposure more than 1mm wide, with abnormal reaction to thermal or electrical stimuli, teeth tender to percussion or with periapical radiolucency. An informed consent form was signed by each patient before starting the procedure.

Immediately after the accidental exposure of the dental pulp as a result of carious dentin excavation, a rubber dam was placed in order to control moisture contamination. The clinical defect was identified by the presence of bleeding or as a pink spot on the floor of tooth cavity. We considered only exposures that were not over 1mm² to be candidates for direct pulp capping. The cavities were rinsed with saline solution and dried with sterile cotton pellets; MTA (ProRoot MTA, Dentsply Tulsa Dental, USA) was placed with gentle pressure on the top of the exposure and covered with a glass ionomer cement (Fuji IX, GC Corp) as temporary restoration.

All the cases were examined clinically (history of pain, response to electrical and thermal tests, percussion) and radiographically. The absence of pain and normal responses to sensitivity tests and absence of apical pathology were considered successful. Those that showed abnormal or no reaction to vitality tests, a history of pain and tenderness to percussion associated or not with periapical radiolucency were considered failures.

The clinical variables were analyzed using SPSS program version 17. For statistical analysis we used Chi-square test and the level of significance was set at a value of $p < 0.05$. Any significant effects on the outcome of the treatment related to age, tooth location, type of exposure and class of restoration was evaluated and a $p < 0.05$ was considered statistically significant.

Results

The results of our study are presented in Tables 1-4, presenting the correlations between clinical results related to age of the patient, tooth location, type of pulp exposure and class of dental restoration, respectively.

Table 1. Correlation between the age of the patient and treatment outcome.

Age	Success (no. and %)	Failure (no. and %)	Total
10-20 years	16 (69.57%)	7 (30.43%)	23
21-30 years	10 (62.50%)	6 (37.50%)	16

($p = 0,36$)

Table 2. Correlation between tooth location and treatment outcome

Tooth location	Success	Failure	Total
Maxillary	10 (55.56%)	8 (44.44%)	18
Mandibular	13 (61.90%)	8 (38.10%)	21

($p = 0,15$).

Table 3. Correlation of type of pulp exposure and treatment outcome

Type of exposure	Success	Failure	Total
Dental caries	9 (29.03%)	22 (70.97%)	31
Trauma	6 (75%)	2 (25%)	8

($p < 0,05$)

Table 4. Correlations between class of restoration and treatment outcome

Cavity	Success	Failure	Total
Class I	12 (85.71%)	2 (14.29%)	14
Class II	13 (59.09%)	9 (40.91%)	22
Class III	2 (66.67%)	1 (33.33%)	3

($p < 0,05$).

Analysis of the data show that there is no significant relationship between the pulp capping procedure and patient age and tooth location. On the other hand, there were differences regarding success of treatment and

type of pulp exposure and class of dental restoration. Pulpal exposure resulted in some degree of hemorrhage in all cases.

Discussion

Dental pulp is a highly vascularized tissue with a great potential for healing; as it performs many functions throughout tooth life, every effort should be made in order to preserve its vitality. Direct pulp capping procedures represent the dressing of an exposed pulp in order to maintain its integrity and function and several factors are involved in the prognosis: materials used, micro-leakage, size of exposure, contamination of cavity prior to this procedure (Camilleri et al 2006, Bogen et al 2008)

Indications for direct pulp capping include recent traumatic exposure or mechanical exposure during cavity preparation. Pulp capping proved to be a valuable method of treatment in immature permanent teeth, where the complete development of the root is a prerequisite for a successful future endodontic therapy. Many studies considered that this method is not suitable for teeth that will serve as abutment for a fixed partial denture or for cases with inflamed pulps (Iwamoto et al 2006, Hilton 2009, Koike et al 2014). Furthermore, preoperative tooth sensitivity has been considered as a contraindication to pulp capping, but this concept is not supported by scientific evidence. The success of this method is discussed controversially in the literature, due to many causes that can produce the pulp exposure.

The main goal of our conservative approach was the long-term maintenance of a healthy dental pulp, enhanced by the new materials and techniques available today. Most of the patients in our group were between 20-30 years because direct pulp-capping is known to be more successful in young individuals, with a high cell population in the pulp which offers the best condition for healing. The results of our study showed that the age of the patient did not influence the final result, which is in agreement with other previous investigations (Bogen et al 2008, Hilton 2009).

The best results were noted where there was a mechanical exposure (75%), less than 1mm² which comes to the clinic within 24 hours from trauma; in this situation the bacterial invasion of the tissue is minimal and the procedure can be performed on a dental pulp without inflammation. For similar conditions, other studies reported a 93% success rate after 1 year; this might be explained by better experience in case selection and technical skills of the operators (Shi et al 2015).

The influence of marginal seal and subsequently, the prevention or reduction in micro-leakage may explain the higher success rate of pulp capping in Class I restorations (85.71%), compared to Class II (59.09%) and III (66.67%). Probably this influence is due to the length of the margin between the tooth structure and the restoration interface, in the longer the

margin the greater the incidence of microbial invasion from oral cavity to pulp chamber.

Bioengineered anti-inflammatory direct pulp capping materials, together with adhesive techniques for leakage prevention have great potential to improve the condition of the dental pulp and to offer higher rates of long-term success (Kobayashi et al 2010).

Although there were only a small number of cases, the results of this study in which we used MTA as a direct pulp-capping agent demonstrate that by this technique we can obtain favorable results. Since our study did not have a control group, the results provide, within the limitations of this investigation, a relatively low level of scientific evidence. However, the outcomes suggest that MTA is a successful and predictable pulp-capping material; the physical characteristics and bioactive properties of MTA were a critical contributing factor to the encouraging results of our study.

Conclusion

The success of pulp capping procedures requires several conditions: control of hemorrhage, the use of a material well tolerated by dental pulp and a bacteria tight seal. In addition, the indication must be restrained to recent traumatic or mechanical exposure in mature permanent teeth with simple restorative needs. Careful attention to diagnostic criteria and treatment procedures should result in many successful outcomes.

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