Application of Partial Pulpotomy in the Treatment of Chronic Pulpitis Caused by Carious in Mature Permanent Teeth: 3 Year-Follow-Up

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Abstract: Purpose: To observe the clinical effect of partial pulpotomy with I Root Bp Plus in cariously exposed mature permanent teeth. Methods: twenty-three cariously exposed mature permanent teeth were choosen by preoperative clinical signs, pulp dynamic examination and imaging examination. After informed consent, rubber barrier was placed. The tooth decay and the inflamed pulp were removed by round bur. After 5% sodium hypochlorite covered the section until sufficient hemostasis was achieved, I Root Bp Plus was used to tightly cover the pulp with a thickness of about 2mm, resin was filled to repaired the shape of the tooth. The capping pulp was examined by X-ray immediately after operation. Clinical and imaging examinations were performed 12 months and 36 months after treatment. Results: After 3 year, the success rate of partial pulpotomy was 86.96%, which is similar as root cannal therapy. Conclusions: The partial pulptomy for caries exposed mature permanent teeth may be an alternative to root canal therapy, and is more consistent with the current concept of minimally invasive and preservation of vital pulp.

Key words: mature permanent teeth; partial pulpotomy; i-root bp plus
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INTRODUCTION

Dental caries is one of the main causes of pulpitis in clinic. The American Endodontics Association believes that root canal therapy (RCT) is necessary for chronic pulpitis caused by dental caries.[1] Because the inflammatory range of the pulp beneath the caries tissue is unknown. However, due to the complexity of root canal system anatomy, such as lateral root canals, accessory root canals, calcified root canals or other factors greatly increased the difficulty of RCT, the success rate of RCT hovering at 68%-85%.[2] Some scholars found that the long-term preservation rate of affected tooth after RCT was significantly lower than that of teeth with living pulp,[3] which may be related to the loss of tooth tissue resistance and pulp nutrition supplies. With the development of modern stomatological techniques and materials,

the concept of pulpitis treatment has changed to "minimally invasive" and "preservation of living pulp". Pulpotomy was a method about removing infected pulp and preserve the remaining healthy pulp tissue. It had been widely used in the treatment of pulp preservation of baby teeth and young permanent teeth. The self-healing ability of dental pulp also provided a physiological basis for the application of pulpotomy in mature permanent teeth. In this study, chronic pulpitis caused by carious in mature permanent teeth were treated with partial pulpotomy and followed up for 3 years to observe and evaluate its curative effect and clinical application value.

MATERIALS AND METHODS

Case collection Twenty-one adult patients (23 mature permanent teeth) who were treated at the First Affiliated Hospital of Zhejiang University Department of Stomatology, from March 2017 to October 2017 were chosen .There were 5 males and 16 females, ranged from 17 to 35 years. (Table 1)

Table 1
The Number of Different Tooth

	Gender		Tooth Position				
	Male	Female	Maxillary anterior teeth	Maxillary premolars	Maxillary molars	Mandibular premolar	Mandibular molar
Numbers	5	16	5	4	2	1	11

Inclusion Criteria

1) Pulpitis caused by dental caries, the teeth with living pulp, no loosening, no percussion pain, and root development completed;

2) No abscess or fistula in peridental and mucosa;

3) X-ray showed normal root and periapical tissue images of the teeth;

4) During the operation, the pulp was flexible, the bleeding was bright red and could be stopped within 5 minutes;

5) All patients gave informed consent with good complianc.

Materials and Instruments

I Root BP PLUS (IBC, Canada); Z350XT Composite resin (3M, USA); Flowable resin (3M,USA); Vitality testing (DENTSPLY,USA); Rubber dam (Coltene, Switzerland); 3% Sodium hypochlorite; Handpiece (NSK, Japan)

Method

Preoperative Preparation

Informed patients of the treatment plans and possible prognosis, informed consent, collected patients informations, including basic informations, subjective symptoms such as spontaneous pain, occlusion pain, etc., clinical examined the range of caries and periodontal status of the affected teeth, temperature testing, vitality testing, preoperative X-ray (Figure 1, Figure 2).

Figure 1 Clinical Pic **Figure 2 X-Ray**

The rubber dam were used to separat from the pollution, and the teeth were locally infiltrated anesthesia by 3% scandouni (without adrenaline) to remove the decayed area and exposed the pulp. (Figure 3). Replaced the sterile ball drill to remove the infected pulp, the section was covered with 3% sodium hypochlorite cotton ball for 5min to fully hemostasis (Figure 4).

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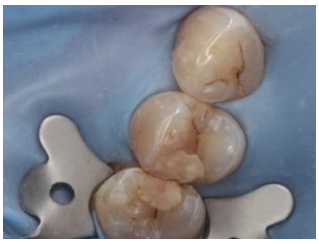

Figure 3 Remove Decay Figure 4 Hemostasis

The I-Root BP Plus was covered on the cross section with a thickness of 2 ~ 3 mm, the flowable resin was used as the bottom, 3M resin filled the teeth, adjusted the occlusal, polished the teeth and postoperative X-ray films were taken(Figure 5, 6).


Figure 5 Cover BP Plus Figure 6 X Ray

Evaluation of therapeutic effects

The criteria for the success of partialpulpotomywere evaluated from clinical and imaging aspects:

The pulp remained active and the response to pulp vitality test was normal

No pain, swelling or fistula

Radiology showed the formation of a repaired dentine bridge

Radiology showed no pathological changes such as intraductal/extraductal absorption, periapical transmission and abnormal calcification

Follow-up Information

The first follow-up information (twelve month):

The patient did not have any discomfort, the filling of the first Maxillary premolar was intact, and there was transient sensitivity in temperature diagnosis. The vitality testing was the same as the control tooth, and there was no discomfort in percussion (Figure 7, 8) .Radiograph showed no obvious abnormalities around the root (Figure 9).


Figure 7a Figure 8a

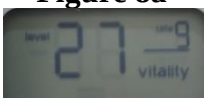

Figure 7b Figure 8b

Fig 9 X-Ray
(Figure 7.8 Vitality Testing)

The second follow-up information (thirty-six month)：

The patient did not have any discomfort, the filling of the first Maxillary premolar was intact. The temperature testing and vitality testing were the same as the control tooth, and there was no discomfort in percussion (Figure 10, 11) .Radiograph showed no obvious abnormalities around the root (Figure 12).


Figure 10a Figure 11a

Figure 10b Figure 11b

Fig 12 X-Ray
(Figure 10.11 Vitality Testing)

RESULTS

After 3 years of follow-up, a total of 23 patients underwent partial pulpotomy, of which 20 were

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successful and 3 failed. The success rate of partial pulpotomy was 86.96% (Table 2).

Table 2
Number of Success and Failure

	No abnormality	Periapical shadows exist	Teeth split
Numbers	20	2	1

CONCLUSIONS

Dental pulp as the same as other loose connective tissue are rich in blood capillary network, lymphatic circulation and immune regulating cell, play to remove inflammatory substances when the pulp damage occurs, virulence factor of defense.[4] At the same time the pulp contains multiple differentiation potential of mesenchymal stem cells, in dental pulp damage is serious in odontoblasts apoptosis, can be raised to the damage area, They differentiated into odontoblast-like cells and formed new restorative dentin. It can be seen that the pulp has the self-repair potential. When the pulp injury is still limited, the removal of infection and the appropriate pulp capping material can induce the formation of restorative dentin and preserve the remaining living pulp. At present, pulpotomy is widely used in young permanent teeth and deciduous teeth pulp treatment, but there are few reports on the treatment in mature permanent teeth,long-term clinical observation is even less.Seltzer et al.[5] conducted a histopathological study on pulpitis that caused by caries and found that the pulpitis tissue range below the dental cavity was less than 2 mm, and the root pulp was generally healthy. It is suggested that the infected crown pulp can be removed and the root pulp may be preserved.

I Root BP Plus is a new type of bioceramic material for vital pulp therapy. In the process of its curing, hydroxide ions are released and permeated into the dentin, so that the pH value increases, thus producing strong antibacterial properties to the common pathogenic bacteria in the infected root canal. At the same time, it has almost no toxicity to pulp and periodontal tissue, and can promote biological mineralization and regeneration of pulp and periodontal tissue.[6] It has been reported that I Root BP plus has a similar effect on the proliferation and differentiation of mouse dental pulp stem cells as MTA, and both of them have no negative effect on the proliferation of human dental pulp cells.[7] Other scholars found that I Root BP Plus has better ability of biomineralization and inducing odontoblast differentiation than MTA. In this experiment, I Root Bp Plus was used as pulp capping material. Through conscious symptoms, clinical examination and imaging examination, the 3-year success rate was 86.96%. The success rate was similar to that of RCT, but it reduces the loss of dental tissue, thus increasing the long-term retention rate of the teeth.

The crown closure after partial pulpotomy is also a factor affecting the success rate of treatment. By analyzing a series of factors, Kunert et al. found that the final restoration method of affected teeth is closely related to the long-term success rate of pulpotomy.[8] The success rate of crown restoration is higher than that of amalgam filling, and resin filling is regarded as a potential risk factor for treatment failure. The reason may be that the resin material has a high probability of long-term microleakage because of its polymerization and shrinkage. At the same time, direct resin filling does not provide resistance protection to some of the teeth with large defect. In this experiment, there were three cases of treatment failure. One of the patients accidentally cracked his tooth while eating. In the other two patients, microleakage was caused by partial shedding of fillings, which may be due to the large defect of teeth and the inability of resin filling to bear the resistance.

Another key of pulpotomy is the assessment of pulp status. However, the clinical evaluation of pulp status has always been difficult and controversial, especially the distinction between

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reversible pulpitis and irreversible pulpitis, Generally speaking, it is necessary to comprehensively judge by the patient's medical history, clinical symptoms, physical signs and imaging information. And if necessary, it can also be assisted by Doppler blood flow detector and measurement of dental pulp oxygen saturation.[9] Temperature test mainly depends on patients' subjective feelings, while Doppler blood flow monitoring and blood oxygen saturation detection can objectively evaluate the blood flow state of dental pulp.[10] Some studies have systematically evaluated several methods for detecting the state of dental pulp. It is found that the accuracy of laser Doppler blood flow monitoring and dental pulp oxygen saturation detection is close to the gold standard, while the electrical activity of dental pulp only shows high accuracy in the detection of living pulp teeth.[11]

RCT often fails due to some anatomical and iatrogenic factors. Pulpotomy can avoid some risk factors, and it can greatly reduce visits and shorten the operation time.[12] In addition, pulpotomy can significantly reduce the loss of tooth tissue, and avoid the resistance damage of tooth. However, at present, pulpotomy has not developed into a treatment comparable to RCT in the pulp management of mature permanent teeth. The scope of indications for pulpotomy is relatively narrow, and the state of dental pulp needs to be strictly evaluated. Moreover, pulpotomy requires aseptic operation and tight crown closure. More clinical data and long-term observation are needed to explore the application value of pulpotomy.

Author Declaration

The authors declare no sponsored financial sources by any organization related to tobacco production for the undertaken study.

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