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Research Article

Effect of iRoot BP Plus Pulpotomy for Immediate Repair in Children with Young Permanent Teeth Crown Fracture

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Abstract: ***Objective:*** To explore the clinical effect of iRoot BP Plus pulpotomy for immediate repair in children with young permanent teeth crown fracture. ***Methods:*** From September 2017 to October 2018, 80 children (80 affected teeth) with young permanent teeth crown fracture who treated in the hospital were selected as the research objects. Random number table method was used to divide them into observation and control groups with each group of forty patients (40 affected teeth). The children in the control group were treated with calcium hydroxide resin, while the observation group were treated with iRoot BP Plus for immediate repair. The surgical success rate was compared between the two groups, and the pulp vitality before and after treatment were compared. ***Results:*** At 3 months and 6 months after surgery, the success rate of children in the observation group was higher than that in the control group, and the difference was statistically significant (P<0.05). The percentage of children with negative pulp activity in the observation group was higher than that in the control group, and the difference was statistically significant (P<0.05). ***Conclusion:*** Immediate repair with iRoot BP Plus pulpotomy in children with young permanent teeth crown fracture has significant clinical effect.

Key words: Young permanent tooth crown fracture; iRoot BP Plus immediate repair in pulpotomy; Pulp vitality

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1 Introduction

As a child is active, their teeth are often broken due to playing, sports or accidents. Therefore, the crown of young permanent teeth is a common dental disease in children. At this stage, the growth of children's roots canal, jaws, and facial contours is in the developmental phase. Improper handling of crown fracture teeth will negatively affect children's pronunciation, occlusion, appearance, and may also cause dental pulp infection and necrosis. Therefore, it is important to take effective measures in time to treat children with this disease[1]. At present, the immediate repair of the disease in the clinic often used pulp capping, and it has certain effects. In recent years, more and more attention has been paid to pulp capping material. Calcium hydroxide and iRoot BP Plus are both commonly used as clinical pulp cap material. However, there are few reports on the effect of the two in the immediate repair of pulpotomy[2]. Based on this, this study further analyses the clinical value of iRoot BP Plus pulpotomy for the treatment of children with young permanent teeth crown fracture. Specific information is as follows.

2 Materials and methods

2.1 General information

From September 2017 to October 2018, 80 children (80 affected teeth) with young permanent teeth crown fractures treated in the hospital were selected as the research objects. Random number table method was used to divide the observation and control groups with each group of forty patients (40 affected teeth). In the observation group, there were 22 boys and 18 girls;

the age ranged from 7 – 12 years, with an average age of (9.63 ± 1.52) years; the period of exposed pulp was 5 – 14 hours, and the average period of exposed pulp was (10.25 ± 2.86) hours. Among the children in the control group, there were 21 boys and 19 girls; the age ranged from 6 – 12 years, with an average age of (9.51 ± 1.61) years; the time of exposed pulp was 6 – 14 hours, and the average time of exposed pulp was (10.31 ± 2.79) hours. The general data of the two groups of children were compared statistically. The difference was not statistically significant (P>0.05), and they were comparable. This study was approved by our medical ethics committee.

2.2 Selection criteria

Inclusion criteria: Crown fracture was diagnosed without root fracture or dislocation by x-ray examination. Treatment history of edentulous area before trauma. The diameter of exposed pulp is more than 1 mm. One with completed clinical and imaging data. One with ideal degree of cooperation. Exclusion criteria: One with allergies. One with coagulopathy. One with congenital heart disease. One with severe organ failure. One with expression disorders or mental illness.

2.3 Methods

The children in the control group were treated with calcium hydroxide resin while the observation group were treated with iRoot BP Plus for immediate repair. The method was as follows: 1.8 ml of mepivacaine hydrochloride (Shandong Chenlong Pharmaceutical Co., Ltd., National Medicine Standard H20110073) were used for local anesthesia in both groups of children, and a large amount of 0.9% sodium chloride solution was used to rinse and trim the section. Then, a high-speed turbo driven handpieces was used to lift up the top of the pulp and observe the pulp condition. Then, a high-speed turbo driven handpieces using sterilization ball to remove about 2 mm of the coronal pulp tissue below the wound surface. Then, a large amount of normal saline and 3% sodium chloride solution were used to rinse the pulp to stop bleeding. If it is still bleeds after rinsing, a sterile dry cotton ball can used to compress to stop bleeding. After drying, children in the observation group were given the iRoot BP Plus (Innvative Bipceramix Inc, Vancouver, Canada), while children in the control group were given the calcium hydroxide paste (Wuhan Wall Pharmaceutical Co., Ltd., Sinopharm H42022320). Then, a vertical decompression filler was used to place each of the two fillers into the pulp section with a thickness of about 2 mm and placed at the bottom of Fuji IX glass ionomer cement (GC Company, Japan). The dentin and enamel layers of the residual crown were repaired with dentin and enamel resins using light cure resin based composite (3M, USA). The jaw was checked and the tooth surface was polished. Patients in both groups were followed up for 6 months.

2.4 Evaluation index

(1)Judgment standard for the success rate of surgery was based on "Endodontics"[3]. A success surgery are the fillings of the affected teeth are not loose, the teeth are intact, the chewing function is normal, the affected teeth have no pain symptoms through hot and cold stimulation. In addition, x-ray examination shows that the root tip continued to grow and develop, and the visible calcification barrier is formed. Whereas, a failed surgery are the loose dental fillings, defects in teeth appearance, and the affected teeth is associated with pulp necrosis, pulpitis and apical inflammation. In addition, x-ray examination reveals that the root tip is not growing and there are lesions formed around it. The surgical success rate was compared between the two groups for 3 months and 6 months after operation. (2) Pulp vitality was compared for 3 months and 6 months after operation. The pulp vitality tester (Pilp vitality tester, Parkell, USA) was used to measure the pulp vitality of the two groups of children, and the number of negative cases was recorded and compared.

2.5 Statistical methods

SPSS 24.0 software was used for data processing. Count data were expressed as percentages and χ^2 test was used. P<0.05 was considered statistically significant.

3 Results

3.1 Surgery success rate

At three months after operation, the success rate of children in the observation group was higher than that in the control group, the difference was statistically significant (P<0.05). At six months after operation, the success rate of children in the observation group was higher than that in the control group, the difference was statistically significant (P<0.05). See Table 1.

Table 1. Comparison of surgical success rates between the two groups

Group	3 months after operation			6 months after operation		
	Success(n)	Failure(n)	Success rate(%)	Success(n)	Failure(n)	Success rate (%)
Control group (n=40)	29	11	72.50	25	15	62.50
Observation group (n=40)	39	1	97.50	38	2	95.00
χ^2	-	-	9.804	-	-	12.624
P	-	-	0.002	-	-	0.000

3.2 Pulp vitality

At 3 months and 6 months after surgery, the percentage of patients with negative pulp activity in the observation group was higher than that in the control group, and the difference was statistically significant ($P<0.05$). See Table 2.

Table 2. Comparison of pulp vitality between the two groups, n (%)

Group	3 months after operation		6 months after operation	
	Negative	Positive	Negative	Positive
Control group (n=40)	26(65.00)	14(35.00)	23(57.50)	17(42.50)
Observation group (n=40)	35(87.50)	5(12.50)	34(85.00)	6(15.00)
χ^2	5.591		7.384	
P	0.018		0.007	

4 Discussion

Due to the immature tissue structure of young permanent teeth, crown fractures are prone to occur after trauma. And it has high medullary angle, large medullary cavity, low degree of calcification, and thin calcified tissue. These can increase the incidence of crown fracture and easily cause infection, which will have a negative impact on children's learning, life and social functions[4-5]. Dental pulp is an important tissue for root development, thus in order to continue the development of the root, effective measures should be taken in time to retain the vital dental pulp tissue[6]. At present, pulpotomy is the main method for clinical treatment of the disease, which has good clinical effect.

Patients with young permanent teeth crown fracture by pulpotomy for immediate repair can effectively remove the risk of infection in coronal pulp to retain the radicular pulp, and insert materials with antibacterial and bactericidal effects at the interface between the root canal and the pulp chamber to promote the continued development of root pulp. Related studies have pointed out that the surgical effect of pulpotomy is closely related to the advantages and disadvantages of the pulp capping material used in surgery[7]. The ideal permanent dental pulp capping material has good sealing and stability, is not easily absorbed, and can induce dental pulp tissue regeneration. Calcium hydroxides, formaldehyde cresol mixture, and bioceramics are all commonly used in clinical capping materials. Among them, bioceramics and calcium hydroxide have the main materials that promote the formation of new calcified tissues on the surface of the pulp. The results of this study show that the surgical success rate of children in the observation group was higher than that in the control group at 3 months and 6 months after operation. The percentage of children with negative pulp activity in the observation group was higher than that in the control group. It shows that iRoot BP Plus pulpotomy is a better treatment for young children with permanent crown fractures than calcium hydroxide. Ding *et al*[8] showed that the success rate of iRoot BP Plus pulpotomy of young permanent teeth is higher than that of calcium hydroxide, which is basically consistent with the results of this study. Calcium hydroxide has strong alkalinity, which is more toxic to dental pulp tissue, and has poor physical stability. It cannot be closely combined with dentin, which will cause porosity defects. However, due to its low cost and high cost performance, it is still clinical widely used. iRoot BP Plus belongs to a new type of bioceramics. Its main ingredients are calcium sulphate, calcium

silicate, superphosphate and tantalum oxide, which has high biocompatibility and can effectively promote pulp tissue development, up-regulates alkaline phosphatase activity and induces dentin differentiation[9-10].

In summary, young children with permanent tooth fractures who have iRoot BP Plus pulpotomy for immediate repair have significant clinical effects, and a high success rate of surgery, which enhance pulp vitality, and are worthy of widespread promotion in clinical application.

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