

A Comparative Study on the Efficacy between Minimally Invasive Caries Removal Technique involving Carisolv and Traditional Mechanical Caries Removal in Treating Dental Caries in Children

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Abstract: Objective: To explore the curative effect of Carisolv, a minimally invasive caries removal technique and traditional mechanical caries removal treatment on children's dental caries. **Methods:** A total of 97 children with dental caries who were treated in the Department of Stomatology in Affiliated Hospital of Chifeng University, Chifeng from September 2017 to May 2019 were selected and recruited as the research subjects. They were divided into two groups by random number table method. Forty-nine individuals were assigned in the control group while the remaining 48 individuals in the observation group. The control group was treated with traditional mechanical caries removal method, and the observation group was treated with minimally invasive caries removal technique, *i.e.* Carisolv. Both groups were followed up for six months. The degree of pain, recovery time of dental function and complications after six months of treatment were observed in the two groups of children. **Results:** During the treatment, compared with the control group, the children in the observation group experienced lower degree of pain and had shorter recovery time of dental function. After six months of treatment, the incidence of complications in the observation group was lower than that in the control group. The difference was statistically significant ($P < 0.05$). **Conclusion:** Compared with traditional mechanical caries removal method, Carisolv, a minimally invasive caries removal technique could reduce the pain of children during the treatment process, shorten the time to restore dental function, reduce the occurrence of complications, and

had a better therapeutic effect in treating children's dental caries.

Keywords: Dental caries; Traditional mechanical caries removal; Minimally invasive caries removal involving Carisolv; Degree of pain

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Dental caries, commonly known as tooth decay, is a common disease in children and has a high incidence. When caries-causing substances are attached to the surface of teeth, acidic substances will be produced in the deep layers of plaque at an appropriate temperature, which will invade dental tissues and demineralize minerals. Subsequently, it destroys organic matter and forms caries. Untreated caries cannot heal by themselves. As the disease progresses, it will eventually lead to the loss of children's teeth, which will seriously affect the children's daily life. Clinically, dental drills are used to treat the disease after filling. As much as dental drills can achieve a certain level of therapeutic effect, the mechanical pressure generated during the treatment, the high temperature of stimulation to the teeth and the disturbing noise will engender trepidation and severe pain in children. As a result, children's treatment coordination becomes low, which negatively affects the treatment effect^[1-2]. Carisolv gel is a new type of material for the treatment of dental caries. It

can gently and thoroughly remove the carious tissue of children, reduce the irritation to children, and has been used widely in clinical practice. The purpose of this study was to investigate the efficacy of Carisolv coupled with the minimally invasive caries removal technique and traditional mechanical removal of children's caries.

1 Materials and methods

1.1 General information

Ninety-seven children with dental caries who were treated in the outpatient clinic of Department of Pediatric Stomatology, Affiliated Hospital of Chifeng University, Chifeng from September 2017 to May 2019 were selected and recruited as the research subjects. They were divided into two groups, i.e. control group and observation group by random number table method. The control group consisted of 49 patients comprising of 27 males and 22 females who were aged 3 - 10 years, with an average age of 6.62 ± 2.54 years. Of the affected teeth in the control group, 86 were identified as moderate caries and 93 were identified as advanced caries. In the observation group, there were 48 cases comprising of 25 males and 23 females who were aged 3 - 10 years, with an average age of (6.67 ± 2.51) years. Of the affected teeth in the observation group, 83 were identified as moderate caries and 91 were advanced caries. The data of the two groups of children were compared using statistical test. $P > 0.05$ if the difference was comparable and not statistically significant. This study was reviewed and approved by the Medical Ethics Committee of Affiliated Hospital of Chifeng University.

1.2 Eligibility criteria for selecting research subjects

(1) Inclusion criteria: Comply with the relevant diagnostic criteria for dental caries in the "Clinical Disease Diagnosis and Efficacy Judgment Criteria"^[3]; The children had open occlusal caries, and the open diameter of dental caries was greater than 1.5 mm; No clinical manifestations of pulp and apical disease; Did not take any antibacterial drugs 2 months before the consultation; Family members of the children agreed to participate.

(2) Exclusion criteria: The root resorption of the child was more than 1/3; Children who had dental pulp disease; Children who had diseases of blood system; Children who had spontaneous pain or night pain; Children with poor compliance.

1.3 Methods

1.3.1 Control group

The children in the control group were treated using traditional mechanical caries removal technique. In the beginning of the treatment process, the affected teeth were first determined. High-speed needle was used to perform molar treatment under water spraying conditions to completely remove the decayed surface of the affected teeth, perform cavity preparation, pulp protection, underlaying, etc. Routine disinfection was performed. After the removal of the decayed tooth, the area should be blown dry with moisture insulation, and subsequently filled with light curing resins for repair.

1.3.2 Observation group

The children in the observation group were treated with Carisolv coupled with minimally invasive caries removal technique. Conventionally, the caries cavity was moistened. Carisolv gel was mixed thoroughly. The gel was applied on a specialized tool which was then used to coat the gel on the surface of the carious cavity to ensure that the entire caries was coagulated with the gel. After 30s, the caries tissue was gently scraped with a specialized tool. If the gel on the caries tissue was substantially polluted by the residue, the residue should be removed using a cotton swab, and then coated with fresh, new gel until the gel is clear and clean. A probe was used to check the bottom and wall of the decayed tooth, there is leather-like hardness or scratching sound. To complete the removal of caries, the carious cavity was rinsed with normal saline, and then blown dry with conventional moisture insulation. The cavity was filled with light curing resin, and the occlusion was adjusted. Both groups were followed up for six months.

1.4 Evaluation index

(1) Degree of pain: The Wong-Baker facial expression scale[4] was used to evaluate the degree of pain that the children of the two groups had to endure in the treatment stage. The scale has a total of four levels. At level I, the child expresses a very happy smile and felt no pain. At level II, the child shows a little discomfort and feels a slight pain. At level III, the child shows signs of crying, feels severe pain, but the pain is tolerable. At level IV, the child cries, feels an unbearable and intolerable pain. (2) The recovery time of dental function of the two groups of children were observed and recorded. (3) Complications: After six months of follow-up, the complications such as

secondary caries, periapical periodontitis, pulpitis, and filler loss were observed in the two groups of children.

1.5 Statistical methods

Statistical Package for the Social Sciences (SPSS), version 20 was used for data processing. The quantitative data was expressed in $\bar{x} \pm s$. Independent sample *t* test was used to compare a variable between two group whereas paired sample *t* test was used for comparison within a group. Categorical data was expressed as percentages. Chi-squared (χ^2) test was

used. Ordinal data was analyzed using rank test. When $P < 0.05$, the difference was considered statistically significant.

2 Result

2.1 Degree of pain

During the treatment, the degree of pain in the observation group was lower than that in the control group, and the difference was statistically significant ($P < 0.05$). See Table 1.

Table 1. Comparison of the degree of pain levels in children between control group and observation group

Group	Level I	Level II	Level III	Level IV
Control group(n=49)	0(0.00)	21(42.86)	18(36.73)	10(20.41)
Observation group(n=48)	9(18.75)	32(66.67)	4(8.33)	3(6.25)
<i>Z</i>			4.679	
<i>P</i>			0.000	

2.2 Recovery time of dental function

The time needed for dental function recovery in the control group was (17.64 ± 3.88) days, while the time needed for dental function recovery in the observation group was (12.27 ± 2.35) days. Comparing the two groups, the time needed for dental function recovery was shorter in the observation group. The difference

was of statistical significance ($t = 8.224, P = 0.000$).

2.3 Complications

After treatment for six months, the incidence of complications in the observation group was significantly lower than that in the control group, and the difference was statistically significant ($P < 0.05$). See Table 2.

Table 2. Comparison of complications in children between control group and observation group n (%)

Group	Secondary caries	Periapical periodontitis	Pulpitis	Filler loss	Total incidence
Control group(n=49)	2(4.08)	2(4.08)	3(6.12)	1(2.04)	8(16.33)
Observation group(n=48)	0(0.00)	0(0.00)	1(2.04)	0(0.00)	1(2.04)
χ^2					4.274
<i>P</i>					0.039

3 Discussion

Dental caries is a common disease in the dental medicine. Dental caries is characterized by the progressive damage to the hard structure of the teeth which is caused by a combination of various factors in the oral cavity. Bacteria, oral environment, and parasites can cause dental caries, or commonly known as the tooth decay. Periodontal periodicitities and pulpitis are secondary to dental caries at the early stage. If not treated in time, dental cavities will appear in the teeth, eventually leading to complete destruction and disappearance of the crown, which will severely affect the physical and mental health, and even daily life of children [5]. Clinically, high-speed mechanical grinding

for caries removal is often used to treat the condition, but the noise produced in the treatment process is very loud. If the treatment operation is performed improperly, the healthy tissue will be damaged and the treatment effect will be negatively affected. Improving caries removal techniques, preventing damage to healthy tissues, and improving treatment effects are the focus of clinical research in recent years.

The findings of this study show that the level of pain in the observation group was significantly higher than that in the control group during the treatments, and the time required for dental function recovery was shorter in the observation group than in the control group. After treatment for six months, the incidence of complication in the children of the observation

group was significantly lower than that of the control group, indicating that compared with the traditional mechanical caries removal treatment, Carisolv coupled with minimally invasive caries removal technique can reduce the degree of pain in the treatment process and shorten the recovery time of children's dental function. In addition, this minimally invasive technique can also reduce the occurrence of complications and has a better treatment effect. Traditional mechanical caries removal technique is a treatment method for removing carious tissue with a high-speed rotating burr, which can effectively remove carious tissue, thereby treating dental caries. However, high-speed rotating burr and high-pressure water spray during treatment can irritate the dental pulp of children, causing pain. Apart from that, the high-pitched noise and high temperature generated from the burr will also have negative impact on the children's behavior, thereby reducing the degree of treatment coordination and affecting the treatment effect. As a result, recovery time of dental function is prolonged, causing adverse reactions such as pulpitis^[6]. Carisolv coupled with minimally invasive caries removal technique is a method using Carisolv gel to remove carious tissue. The advantages of this technique include simple treatment operation, reduced stimulation, good treatment effect, and reduced pain. Carisolv gel contains two chemical substances, amino acid and sodium hypochlorite, which react to produce chlorinated amino acids that reduce the corrosiveness of sodium hypochlorite to teeth, while fully retaining the deionization characteristics of the original substance. While Carisolv gel softens and cleanses the carious tissue, healthy teeth which were unaffected by decay can be protected from being damaged. Thus, this method can reduce the rate of complications and accelerate the recovery of dental function in children^[7-8]. At the same time, the minimally invasive caries removal technique creates a relatively quiet treatment environment for the children as this technique reduces the noise and irritation of teeth which are commonly caused by the traditional mechanical method. Therefore, this technique relieves tension and fear, reduces pain endured by the children, and improves treatment coordination, thereby improving the treatment effect^[9]. In addition, since the Carisolv gel is alkaline, the acidic substances which are produced by caries inflammation can be neutralized, thereby exerting

anti-inflammatory and analgesic effects, protecting the pulp, and reducing complications such as pulpitis and periapical periodontitis^[10].

In conclusion, compared with the traditional mechanical caries removal treatment in children, Carisolv coupled with minimally invasive caries removal technique can reduce the degree of pain during the treatment, shorten the recovery time of dental function, reduce the occurrence of complications, and improve the treatment effect in the children with dental caries.

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