Comparison of the Performance of Gentian Violet Solution on Three Kinds of Concentration in the Microleakage Detection Experiments of Obturator

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ABSTRACT Objective: To investigate the performance of gentian violet solution on three kinds of concentration in the microleakage detection experiments of obturator by detecting the depth of their penetration in the edge of obturator. Methods: Thirty recently extracted human second premolars teeth were chosen and standardized mixed Class V cavities (4 mm × 3 mm and 2 mm deep[1,2]) were cut on the buccal surfaces with the gingival margins placed 1.0 mm above the cemento-enamel junction (CEJ). The teeth were randomly assigned into 3 groups (A/B/C, n=10): Conventional resinous fillings. After keeping the specimens for 24 hours at 37 degrees C and 100% humidity, they were thermocycled for 400 cycles at 5℃ and 55℃, sealed with nail varnish except 1 mm beyond the margins of restoration twice, and then separately immersed in different concentrational gentian violet basic for 96 hours (0.5%, A;1%, B;2%, C). Samples were then sectioned mesiodistally and viewed at 40× magnification under a root canal microscope for leakage at the gingival margin and taken pictures. The microleakage was measured with the image analysis software Image-Pro Plus 6.0 and the data were recorded in data of dye penetration to the whole path from the cavosurface margin of the proximal boxes to the end of the post. Analysis of variance and the T-test were used to evaluate the data (P=0.05). Results: The depth of the penetration of gentian violet solution of the three groups of teeth separately were A (0.59± 0.22)mm, B (1.38± 0.32)mm, C (1.52± 0.45)mm. There were significant differences among the three groups in the depth of the penetration of gentian violet solution (F=21.431，P＜0.05). And there were significant differences between A and B (t=5.138，P＜0.05), also between A and C (t=6.082，P＜0.05). But not between B and C (t=0.944，P＞0.05). Conclusions: With regards to microleakage, the penetration speed of gentian violet solution of 1% and 2% was the biggest. That of 0.5% is a little smaller. The penetration stability of gentian violet solution of 0.5% was the best, and that of 1% was worse, while that of 2% was the worst.

Key words: Gentian violet solution; Microleakage; Root canal microscope

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Introduction

Microleakage of obturators means potential cavities which can be found between obturators and teeth after fillings of cavities. That could not be detected on clinic. Afterwards, bacteria, acid and enzyme will permeate into the cavities, edge of obturators will discolorate, secondary caries will be found, and then pulp diseases and periapical diseases may turn up [3,4]. At present, there are a lot of kinds of materials of obturators which have different characters. But they all can not completely refrain from miroleakage. As new materials of cavity fillings will be produced endlessly, experiments about microleakage will go on. There are a great many ways to detect microleakage of obturators. The dye penetrant test and the scanning electron microscope method are the most frequently-used ways. And the dye penetrant test is easer to use, its results are easier to quantify. This experiment will compare the performance of gentian violet solution on three kinds of concentration in the microleakage detection experiments of obturator, by measuring the depth of their penetration in the edge of obturator. It was to offer some reliable evidence for selection of dye when use the dye penetrant test in the microleakage detection experiments of obturator.

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1 Materials and methods

1.1 Materials and Instruments

Charisma resin A2 shade (Heraeus Kulzer, Germany), Gluma general-purpose desensitizer (Heraeus Kulzer, Germany), Gluma 20% general-purpose phosphoric acid etching agents (Heraeus Kulzer, Germany), LEICA M300 DENT Dental Operating Microscope (LEICA，Germany), coarse-grit diamond bur (Mani, Japan), Palm Light™ V-type light curing unit (CAO GROUP,INC., USA), high-speed Handpiece (Kavo, Germany), gentian violet(Bodi Chemical industry Co., Ltd. , Tianjin), constant temperature water bath (Zhongda Instrument Factory, Jiangsu, Jintan.)

1.2 Teeth collection and grouping

1.2.1 Methods of Experimental Thirty extracted human premolars which were removed for the sake of orthodontic treatment were randomly divided into 3 groups (A/B/C, n=10). Selection crit-

eria for extracted teeth are as follows: ①Without caries and wedge-shaped defect on the complete extracted teeth; ②Without root canal cracked、creeping caries observed under the microscope; ③Without crown fracture and root fracture; ④Without discoloration of teeth, such as enamel hypoplasia, dental fluorosis, tetracycline stained teeth, and so on.

1.2.2 Specimen Preparation Standardized mixed Class V cavities (5 mm × 3 mm and 2 mm deep) were cut on the buccal surfaces with the gingival margins placed 1.0 mm above the CEJ. A diamond bur was used on only five cavities. Afterwards, those cavities were rinsed and dried, 20% general-purpose phosphoric acid etching agents was coated on cavity wall and etching for 30s. Then cavity walls were washed for 15 s and dried with water and air gun. Gluma general-purpose desensitizer was coated on cavity wall, then it was blew to a thin layer. Light curing unit was placed 2mm away from cavity walls and lighted for 20s. Following this, with pressure, charisma A2 resin was diagonally filled Layer by layer then lighted. Fine-grained diamond bur and rubber wheel were used to polish the surface of obturator and teeth.

1.2.3 Thermal Cycles After keeping the specimens for 24 hours at 37 ℃ and 100% humidity, they were thermocycled for 400 cycles at 5℃ and 55℃[5] in constant temperature saline. It taked 1 minite for one cycle. Lately the apical foramens of specimens were sealed with stick wax, while the tooth surface, 1mm out of the edge of obturator, was evenly coated with colorless nail polish twice.

1.2.4 Dyeing The three groups of teeth were separately immersed in different concentrational gentian violet basic for 96 hours (0.5%, A;1%, B;2%, C).

1.2.5 Cut and Take pictures Samples were then sectioned mesiodistally and viewed at 40× magnification under a root canal microscope for leakage at the gingival margin and taken pictures. Three quartering points of their gingival walls of the obturators were chosen to cut in.

1.2.6 Data measure and Analysis The microleakage was measured with the image analysis software Image-Pro Plus 6.0 and the data were recorded in data of dye penetration to the whole path from the cavosurface margin of the proximal boxes to the end of the post. Analysis of variance and the LSD-t test were used to evaluate the data (P=0.05)[6]. Take average of the penetration depth of three measurement points. SPSS 18.0 statistical software package was used to analyze those data.

2 Results

The penetration depth of the three kind of gentian violet solution was shown in Table 1. The depth of the penetration of gentian violet solution separately were A(0.59± 0.22)mm, B (1.38± 0.32) mm, C (1.52± 0.45)mm. There were significant differences among the results of the three groups (F=21.431，P＜0.05). Pairwise comparison results were shown in Table 2. The penetration speed of gentian violet solution of group B was bigger than that of group A. (t=5.13, P＜0.05). The penetration speed of gentian violet solution of group C was bigger than that of group A. (t=6.082, P＜0.05). The penetration speed of gentian violet solution of group B was similar with that of group C (t=0.944, P＞0.05).

Table 1 Penetration depth of the three kind of gentian violet solution

Group	N	X^2	S	Min	Max	F	P
A	10	0.59	0.22	0.36	1.00		
B	10	1.38	0.32	0.85	1.76	21.431	0.000
C	10	1.52	0.45	0.66	2.01		

Table 2 Pairwise comparison results

Group(I)	Group(J)	I-J	SE	t	P
A	B	0.782	0.152	5.138	0.000
A	C	0.926	0.152	6.082	0.000
B	C	0.144	0.152	0.944	0.354

3 Discussion

Microleakage of obturators means that small channel could be found between obturators and teeth, afterwards, bacteria, liquids and other hazardous materials will permeate into the cavities, which result in a series of adverse consequences[4,7,8]. When microleakage happens, tooth sensitivity, cavity edge discoloration, secondary caries and pulpitis may occur on vital teeth; Root canal treatment failure may occur on teeth finished that treatment. Currently, there are many research on microleakage, most of which used dye penetration method, but their experimental conditions were often different, lacking of uniform standards.

Thermal cycling test is recognized as the best way to simulate oral temperature changes. Previous studies showed that, microlea-

kage of obturators could be increased by thermal cycles[9,10]. Moreover, with the increasing in the number of thermal cycles, restoration of microleakage increases [11,12]. Therefore, our diet which has reduced cold and hot food may have a positive impact on resin restorations in the long run. In this experiment, in order to simulate restorations in the oral cavity, all specimens were thermal cycled in constant temperature saline.

How long specimens immersed in the dye? In various experiments on microleakage of obturators, the immersing time of specimens were unequal, commonly 24h[11,13,14,15], 48h[16,17] and a week[18,19]. On this basis, combined with several pretest, 96h was determined as the dye immersing time in this experimental conditions. Then, in 90% of the specimens, dye had penetrated to half of depth of cavity walls.

In similar trials in the past, different scholars chose different ways to measure the depth of penetration. In the past, obturators were cut into four parts, six interfaces were measured, and the six data were taken averaged. However, the current study evaluated microleakage at the occlusal and gingival margins, and the gingival margins had higher microleakage than the occlusal in Classic V cavities [20]. Therefore, it is more reasonable to measure the gingival wall and occlusal separately. This experiment took dye penetration depths of gingival wall averaged as sample data.

The experimental results showed that, in this experimental conditions, the penetration speed of gentian violet solution of 1% and 2% was the biggest, while 0.5% is a little smaller. The penetration stability of gentian violet solution of 0.5% was the best, while 1% was a little worse, and 2% was the worst.

As materials science advances, the closure performance of the obturators will get better and better, then 1% gentian violet solution with the fastest penetration is the best choice. For some materials with poor closure performance such as glass ionomer or temporary closure of materials, excessive penetration rate will create difficulties for experiments, now 0.5% or 2% gentian violet solution was best. For some experiment with relatively less samples, the differences in data between the various samples was as small as better, in which case 2% gentian violet solution should be chosen.

With the developments of new types of bonding and filling materials, microleakage detection experiments of obturator will go on. Many of them are repeated experiments on the same material. If an uniform experimental condition is selected in similar experiments, the exprimental results can be made a horizontal comparison among to a certain degree. This can not only avoid duplication of effort effectively, but also lay a good foundation for Medical consultation card.

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3 种浓度龙胆紫溶液在充填体微渗漏检测中的性能比较

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摘要 目的:通过测量 3 种不同浓度龙胆紫溶液浸入充填体边缘的深度,比较三者在充填体微渗漏检测实验中的性能。方法:将因正畸治疗拔除的人离体前磨牙 30 颗随机分为 A、B、C3 组,每组 10 颗。于离体牙颊面釉牙骨质界冠方 1mm 处制备 4mm× 3mm× 2mm 的标准 V 类洞型。常规树脂充填并经冷热循环(5℃/55℃,400 次)后分别放入浓度为 0.5%(A 组)、1%(B 组)、2%(C 组)的龙胆紫溶液中浸泡 96h。三用枪冲洗吹干后将离体牙沿颊舌向垂直于充填体表面片切。在根管显微镜下观察离体牙充填体边缘染料浸入情况并摄片。采用 Image-Pro Plus 6.0 图像分析软件测量龙胆紫溶液浸入深度并记录。结果:A、B、C3 组龙胆紫溶液渗入深度分别为(0.59± 0.22)mm、(1.38± 0.32)mm、(1.52± 0.45)mm,3 组结果之间有统计学差异(F= 21.431,P<0.05)。其中 A、B 组有统计学差异(t= 5.138,P<0.05),A、C 组有统计学差异(t= 6.082,P<0.05),B、C 组无统计学差异(t= 0.944,P>0.05)。结论:2%、1%龙胆紫溶液渗透速度较快,0.5%龙胆紫溶液渗透速度最慢;0.5%龙胆紫溶液组渗透稳定性较好,1%龙胆紫溶液次之,2%龙胆紫溶液渗透稳定性最差。

关键词 龙胆紫 微渗漏 根管显微镜

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