

[DOI] 10.12016/j.issn.2096-1456.2022.07.005

· 临床研究 ·

树脂水门汀类牙本质粘接剂的不良反应及其相关因素回顾性分析

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【摘要】 目的 探讨树脂水门汀用于牙本质粘接的不良反应发生情况及其相关因素。方法 选择使用树脂水门汀类牙本质粘接剂进行复合树脂直接修复,或全冠间接修复治疗的牙体缺损患者作为研究对象,回顾性分析其治疗后7 d、1个月、3个月、6个月及1年牙体牙髓病变、软组织不良反应、修复体松动脱落等不良反应的发生情况及原因。结果 在使用树脂水门汀类牙本质粘接剂的5 971位患者14 776例患牙中,共计发生580例次(3.93%)不良反应。单因素分析示,治疗后7 d、1个月、12个月,修复类型为“全冠(桥)”的患牙不良反应发生率最高;治疗后7 d,预备层次为“预备后近髓”的患牙不良反应发生率最高;治疗后7 d和3个月,粘接面处理方式采用“牙本质处理剂-粘接剂-树脂”的患牙不良反应发生率最高。多因素分析结果显示,治疗后7 d“牙体预备穿髓后盖髓”为不良反应发生的危险因素($OR=2.610$),治疗后7 d及3个月以“牙本质处理剂-粘接剂-树脂方式处理粘接面”为不良反应发生的保护因素(OR 均小于1)。结论 树脂水门汀类牙本质粘接剂用于直接或间接修复时,牙体预备层次和粘接面处理方式可影响不良反应的发生率,牙体预备穿髓后盖髓及自酸蚀粘接易导致不良反应发生。

【关键词】 树脂水门汀; 牙本质粘接; 牙体缺损; 复合树脂修复; 冠修复; 不良反应; 牙体牙髓病变; 软组织不良反应; 修复体松动; 单因素分析; 多因素分析; 回顾性研究

【中图分类号】 R78 **【文献标志码】** A **【文章编号】** 2096-1456(2022)07-0491-08

【引用著录格式】 付馨靓,孙吉宇,朱卓立,等.树脂水门汀类牙本质粘接剂的不良反应及其相关因素回顾性分析[J].口腔疾病防治,2022,30(7):491-498. doi:10.12016/j.issn.2096-1456.2022.07.005.

Retrospective analysis of adverse reactions and related factors of resin cement dentin adhesive FU Xinliang, SUN Jiyu, ZHU Zhuoli, GAN Xueqi. State Key Laboratory of Oral Diseases, National Clinical Research Center for Oral Diseases, Department of Prosthodontics, West China Hospital of Stomatology, Sichuan University, Chengdu 610041, China

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【Abstract】 Objective To investigate the adverse reactions of resin cement used for dentin bonding and its influencing factors. **Methods** Patients with dental defects treated with resin cement dentin adhesive for direct composite resin repair or full crown indirect repair were selected as the research objects. The occurrence and causes of adverse reactions, such as dental pulp lesions, soft tissue adverse reactions, and restoration loosening and falling off 7 days, 1 month, 3 months, 6 months, and 1 year after treatment, were analyzed retrospectively. **Results** Among the 14 776 teeth of 5 971 patients who used resin cement dentin adhesive, 580 cases (3.93%) had adverse reactions. Univariate analysis showed that the incidence of adverse events was highest in teeth with the "full crowns (fixed partial dentures)" restoration type at 7 days, 1 month, and 12 months after treatment. At 7 days after treatment, the incidence of adverse events was the highest in teeth with a preparation depth of "near pulp after preparation". At 7 days and 3 months after

【收稿日期】 2021-10-28; **【修回日期】** 2022-01-16

【基金项目】 国家自然科学基金项目(81870802);四川省药品监督管理局牙本质粘接剂不良事件重点监测项目(0040305302066)

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treatment, the incidence of adverse events was the highest in teeth with "dentin conditioner-adhesive-resin" treatment of the bonding surface. Multivariate analysis indicated that pulp perforation and pulp capping after tooth preparation were risk factors for adverse events 7 days after treatment ($OR=2.610$), and the "dentin primer-adhesive-resin" bonding surface treatment method was a protective factor for adverse events 7 days and 3 months after treatment ($OR < 1$).

Conclusion When resin cement dentin adhesives are used for direct or indirect restoration, the tooth preparation level and bonding surface treatment method may affect the occurrence of adverse events, pulp perforation, and pulp capping after tooth preparation, and self-etching bonding may contribute to adverse reactions.

【Key words】 resin cement; dentin bonding; tooth defect; compound resin restoration; crown restoration; adverse reactions; dental pulp lesions; soft tissue adverse reactions; restoration loosening; univariate analysis; multivariate analysis; retrospective study

J Prev Treat Stomatol Dis, 2022, 30(7): 491-498.

【Competing interests】 The authors declare no competing interests.

This study was supported by the grants from National Natural Science Foundation of China (No.81870802) and Sichuan Medical Products Administration (No.0040305302066).

牙本质粘接剂是指用于牙本质的粘接材料。树脂水门汀是牙本质粘接剂的主要类别,是指一类具有粘固或粘接性能的树脂基复合材料,最早出现于1952年,以甲基丙烯酸甲酯为基础,因其出色的粘接效果、较高的机械强度与良好的美学效果,被广泛应用于口腔修复临床治疗。而树脂水门汀中含有的残留未聚合单体、单体的水解产物及其他成分(如:单体衍生物、次降解产物、低聚物等)的刺激性与潜在毒性,可导致术后牙本质敏感、牙髓炎等不良反应。本文通过回顾性分析树脂水门汀用于牙本质粘接的不良反应发生情况,探讨不良反应发生的原因,以期为临床实践提供指导。

1 资料和方法

1.1 研究对象

选择2018年4月至2018年9月就诊于四川大学华西口腔医院牙体牙髓科及修复科5 971位患者的15 061例患牙为研究对象。纳入标准:①牙体缺损,需进行直接或间接修复,病历记录及收费记录显示修复治疗中使用了树脂水门汀类牙本质粘接剂;②修复前均已完成必要的牙周、牙髓治疗或桩核修复;③患牙无叩痛,无明显松动;④牙龈颜色质地等无明显异常,口腔卫生状况良好;⑤X线牙片示根尖无暗影且(或)根充良好;⑥牙槽骨无严重吸收,颞下颌关节及咬合关系正常,达到可修复标准;⑦患者无严重的系统病史。排除标准:①患牙有严重的牙周病或未治愈的牙髓根尖周病,无法进行修复;②患牙牙体缺损过多,无法进行修复;③患牙行直接或间接修复后直至整个回

访期间,进行了其他治疗。纳入患者一般情况见表1。

表1 纳入患者一般情况
Table 1 General information of patients

	Number of cases	Component ratio (%)
Gender		
Female	9 944	67.30
Male	4 832	32.70
Age/year		
< 1	0	0
1 ~ 4	0	0
5 ~ 14	146	0.99
15 ~ 44	9 347	63.26
45 ~ 64	3 814	25.81
≥65	1 469	9.94
Smoking		
No	10 941	74.05
Yes	3 803	25.74
Quit	32	0.22
Allergic history		
No	14 696	99.46
Yes	80	0.54
History of systemic disease ($n = 438$)		
Hypertension	175	39.95
Diabetes mellitus	43	9.82
Oral mucosal diseases	0	0
Heart disease	50	11.42
Nervous system disease	3	0.68
Others	167	38.13

Age was classified according to International Classification of Diseases (ICD-9): babyhood: under 1 year old, infants: 1-4 years old, children: 5-14 years old, young adults: 15-44 years old, middle age: 45-64 years old; old: age 65 and above

1.2 临床操作方法

本研究为回顾性研究,不对患者的治疗方案及医师的临床操作进行任何干预措施,按照四川大学华西口腔医院临床医师进行牙体缺损修复的标准操作流程进行操作。

龋损、楔状缺损、外伤缺损的直接修复遵循复合树脂直接粘接修复规范进行操作^[1]:使用SE BOND™牙科树脂粘合剂(小套装)(粘接预处理剂+粘合剂)(可乐丽菲露株式会社,日本)1 664例(11.26%);或使用3M ESPE Adper™ Easy One自酸蚀粘接剂粘接(3M Deutschland GmbH)11 507例(77.88%)。

间接修复的流程如下:

1.2.1 修复前准备 对患者进行口腔检查,选择符合纳入标准的患牙。根据患者病情制定治疗计划,选择适合的修复体;记录患者牙体缺损牙位及牙髓状况。

1.2.2 牙体预备 在自然光下比色,而后进行牙体预备(切骀面→唇舌(腭)面→邻面→颈部→轴面角→精修抛光);制取印模并制作模型,制作全瓷全冠修复体(均由华西口腔医院制作中心统一完成);临时修复体制作。

1.2.3 修复体试戴与粘接 试戴修复体,检查形态颜色、边缘密合性、邻面接触点等,调整咬合接触,抛光;使用3M ESPE RelyX™ U200 Automix自粘接树脂水门汀(3M Deutschland GmbH),1 605例(10.86%),完成粘接并清理多余粘接剂。临床操作均由华西口腔医院修复科医师按照统一标准完成。

1.3 随访记录不良反应

治疗结束后7 d、1个月、3个月、6个月及1年后,电话回访患者有无不良反应,由4名调查人员

执行,2名临床医师监督。出现不良反应者,记录其不良反应类型及发生时间,复诊检查确认并作相应处理。不良反应主要包括:①牙体牙髓病变,例如牙本质敏感、继发龋、继发牙髓炎、根尖周炎等;②软组织不良反应,例如粘接修复后,出现牙龈红肿、不适、出血等症状,其中以牙龈炎最为常见;③修复体部分或全部松动或脱落;④美学相关不良反应,例如充填/修复体颜色改变、牙龈缘着色等。

1.4 统计学分析

采用SAS 9.4软件对数据行卡方检验和Logistic回归分析,检验水准 $\alpha=0.05$ 。

2 结果

2.1 不同不良反应表现总体情况

本研究共纳入15 061例患牙,失访285例,实际纳入14 776例,失访率为1.89%。回访发生不良反应的共580例,不良反应发生率为3.93%。具体可归纳为牙本质敏感、脱落、继发龋、冷、热刺痛、酸痛、牙龈发炎、充填/修复体颜色改变7大类不良反应表现(部分患者出现两种或两种以上不良事件表现)。随着治疗后时间的延长,不良反应的发生率呈下降趋势;在治疗后的不同时期主要发生的不良反应也存在一定差异,治疗后7 d和1个月主要发生的不良反应为牙本质敏感和冷、热刺激痛,治疗后3个月主要发生的不良反应为冷、热刺激痛,治疗后6个月主要发生的不良反应为继发龋,治疗后12个月主要发生的不良反应为脱落,可提示临床医师做出针对性应变和预防。具体每个时间段不同不良反应表现的相关信息见表2。

不良反应的影响因素分析结果显示:不同性别、年龄段、吸烟史、过敏史的患者,不良反应发生

表2 不同时间点不同不良反应表现情况

Table 2 Performance of different adverse reactions at different timepoints

n(%)

Manifestations of adverse reaction	After operation					Total	Total incidence of adverse reaction
	7 d	1 month	3 months	6 months	12 months		
Hypersensitivity	158 (27.24)	47 (8.10)	6 (1.03)	4 (0.69)	3 (0.52)	218 (37.59)	1.48%
Cold and heat stimulating pain	112 (19.31)	70 (12.07)	13 (2.24)	8 (1.38)	2 (0.34)	205 (35.34)	1.39%
Sour stimulating pain	7 (1.21)	4 (0.69)	1 (0.17)	0 (0.00)	0 (0.00)	12 (2.07)	0.08%
Pulpitis	0 (0.00)	11 (1.90)	7 (1.21)	8 (1.38)	7 (1.21)	33 (5.69)	0.22%
Gingivitis	9 (1.55)	13 (2.24)	4 (0.69)	4 (0.69)	0 (0.00)	30 (5.17)	0.20%
Secondary caries	6 (1.03)	0 (0.00)	0 (0.00)	21 (3.62)	3 (0.52)	30 (5.17)	0.20%
Restoration loose	10 (1.72)	1 (0.17)	2 (0.34)	7 (1.21)	20 (3.45)	40 (6.90)	0.27%
Color change of filling/restoration	0 (0.00)	0 (0.00)	0 (0.00)	1 (0.17)	11 (1.90)	12 (2.07)	0.08%
Total	302 (52.07)	146 (25.17)	33 (5.69)	53 (9.14)	46 (7.93)	580	3.93%

率的差异无统计学意义。不同基牙牙髓情况病例,不良反应发生率的差异无统计学意义。

2.2 不同修复类型在不同时间出现不良反应情况

在修复类型为“全冠”的患牙中,不良反应发生率最高,共有77例,不良反应发生率为4.80%;在修复类型为“外伤缺损充填”的患牙中,不良反应发生率最低,仅5例,不良反应发生率为2.86%;除全冠修复患牙外,其余患牙都是在术后7 d内最易发生不良反应,具体情况见表3。卡方检验的结果为,在术后7 d、1个月和12个月进行回访的报告中P值分别为0.023、0.016、0.047,差异有统计学意义,可以认为在治疗后7 d、1个月和12个月不同修复类型患者的不良反应发生率不同。

2.3 不同预备层次在不同时间出现不良反应情况

在预备层次方面,除去1例预备层次为“无”(预备层次数据记录缺失),纳入14 775例患牙进行分析。在预备层次为“预备后近髓”的患牙中,不良反应发生率最高,有266例,不良反应发生率为4.35%;在预备层次为“预备至牙釉质层”的患者中,不良反应发生率最低,有6例,不良反应发生率为2.55%。除预备层次为“预备穿髓后盖髓”的患

牙外,其余患牙都是在术后7 d内最易发生不良反应,具体情况见表4。卡方检验结果为,仅在术后7 d进行回访的报告中 $P < 0.001$,差异有统计学意义,可以认为在治疗后7 d不同预备层次患牙的不良反应发生率不同。

2.4 不同粘接面处理方式在不同时间出现不良反应情况

在粘接面处理方式采用“牙本质处理剂-粘接剂-树脂”的患牙中,不良反应发生率较高,共有90例,不良反应发生率为5.41%;在粘接面处理方式采用“自酸蚀-树脂”的患牙中,不良反应发生率较低,共有490例,不良反应发生率为3.74%,具体情况见表5。卡方检验结果为,在治疗后7 d和3个月,P值分别为0.006、0.008,差异有统计学意义,可以认为在治疗后7 d和3个月,不同粘接面处理方式的患者不良反应发生率不同。

2.5 不良反应的相关因素分析

根据单因素分析结果,以“是否发生不良反应”为结果建立二分类Logistic回归模型,将有统计学意义的变量:修复类型、预备层次、粘接面处理方式纳入并拟合模型(赋值见表6)。删除了预备

表3 不同修复类型在不同时间出现不良反应情况

Table 3 Statistics of adverse reactions in different restoration types at different timepoints n(%)

Restoration Types	After operation					Total	
	7 d	1 month	3 months	6 months	12 months	Number of adverse reactions	Case number
Dental caries filling	228 (2.25)	93 (0.92)	18 (0.18)	40 (0.39)	31 (0.31)	410 (4.04)	10 146
Full crowns (fixed partial dentures)	26 (1.62)	27 (1.68)	8 (0.50)	6 (0.37)	3 (0.19)	70 (4.36)	1 605
Wedge-shaped defect	48 (1.68)	26 (0.91)	7 (0.25)	5 (0.18)	9 (0.32)	95 (3.33)	2 850
Trauma defect filling	0 (0.00)	0 (0.00)	0 (0.00)	2 (1.14)	3 (1.71)	5 (2.86)	175
Total	302 (2.04)	146 (0.99)	33 (0.22)	53 (0.36)	46 (0.31)	580 (3.93)	14 776
χ^2	9.029	10.349					
P	0.023	0.016	0.109*	0.086*	0.047*		

*: since the theoretical frequency is less than 1, Fisher's exact probability method is used

表4 不同预备层次在不同时间出现不良反应情况

Table 4 Statistics of adverse reactions in different tooth preparation levels at different timepoints n(%)

Tooth preparation depth	After operation					Total	
	7 d	1 month	3 months	6 months	12 months	Number of adverse reactions	Case number
Prepared to dentin	114 (2.08)	57 (1.04)	16 (0.29)	19 (0.35)	20 (0.36)	226 (4.12)	5 493
Near pulp after preparation	155 (2.53)	59 (0.96)	9 (0.15)	23 (0.38)	20 (0.33)	266 (4.35)	6 115
Pulp capping after pulp exposure	29 (0.99)	30 (1.02)	8 (0.27)	9 (0.31)	6 (0.20)	82 (2.80)	2 932
Prepared to enamel	4 (1.70)	0 (0.00)	0 (0.00)	2 (0.85)	0 (0.00)	6 (2.55)	235
Total	302 (2.04)	146 (0.99)	33 (0.22)	53 (0.36)	46 (0.31)	580 (3.93)	14 775
χ^2	23.816	2.554					
P	< 0.001	0.466	0.328*	0.478*	0.605*		

*: since the theoretical frequency is less than 1, Fisher's exact probability method is used

表5 不同粘接面处理方式在不同时间出现不良反应情况

Treatments of bonding surface	After operation					Total	
	7 d	1 month	3 months	6 months	12 months	Number of adverse reactions	Case number
Self-etch-resin	253 (1.93)	127 (0.97)	24 (0.18)	46 (0.35)	40 (0.31)	490 (3.74)	13 112
Dentin conditioner-adhesive-resin	49 (2.94)	19 (1.14)	9 (0.54)	7 (0.42)	6 (0.36)	90 (5.41)	1 664
Total	302 (2.04)	146 (0.99)	33 (0.22)	53 (0.36)	46 (0.31)	580 (3.93)	14 776
χ^2	7.601	0.453	6.955*	0.202	0.147		
P	0.006	0.501	0.008*	0.654	0.702		

*: since the theoretical frequency is less than 5 and greater than 1, the continuity corrected Chi-square test is used

表6 变量赋值

Table 6 Variable assignment

Factors	Factors included in the analysis	Dummy variable assignment	Reference group
A	Restoration types	Dental caries filling = (1, 0, 0), full crowns (fixed partial dentures) = (0, 1, 0), trauma defect filling = (0, 0, 1)	Wedge-shaped defect = (0, 0, 0)
B	Tooth preparation depth	Pulp capping after pulp exposure = (1, 0, 0), near pulp after preparation = (0, 1, 0), prepared to enamel = (0, 0, 1)	Prepared to dentin = (0, 0, 0)
C	Treatments of bonding surface	Dentin conditioner-adhesive-resin = 1	Self-etch-resin = 0

A total of 14 775 cases with complete information were included for analysis. The standard of selected variables is $\alpha_{in} = 0.05$, the standard of excluded variables is $\alpha_{out} = 0.10$, and the Backward: LR backward stepwise method is selected for analysis. The results show that the model is statistically significant overall

层次为“无”1例,共14 775例。共纳入14 775条信息完整的病例进行分析。入选变量的标准为 $\alpha_{in} = 0.05$,剔除变量标准 $\alpha_{out} = 0.10$,选择 Backward: LR 向后逐步法进行分析,结果显示模型总体有意义。

治疗后7 d,因使用牙本质粘接剂而发生不良反应的,且具有统计学意义的因素如下:①修复类型(参照=楔状缺损充填,龋损充填 $OR < 1$),即控制其他影响因素后,修复类型为楔状缺损充填的患牙发生不良反应的风险比最高;②预备层次(参照=预备至牙本质层,预备穿髓后盖髓 $OR = 2.610$, 95% $CI = 1.694 \sim 4.022$),即控制其他影响因素后,预备层次为预备穿髓后盖髓的患牙发生不良反应的风险比是预备至牙本质层患牙的2.610倍;③粘接面处理方式(参照=自酸蚀-树脂,牙本质处理剂-粘接剂-树脂 $OR < 1$),即控制其他影响因素后,粘接面处理方式为自酸蚀-树脂的患牙发生不良反应的风险比最高,见表7。

治疗后3个月因使用牙本质粘接剂而发生不良反应的,且具有统计学意义的因素如下:①修复类型(参照=楔状缺损充填,全冠 $OR < 1$),即控制其他影响因素后,修复类型为楔状缺损充填的患者发生不良反应的风险比最高;②粘接面处理方式(参照=自酸蚀-树脂,牙本质处理剂-粘接剂-树

脂 $OR < 1$),即控制其他影响因素后,粘接面处理方式为自酸蚀-树脂的患牙发生不良反应的风险比最高,见表8。

3 讨论

牙体缺损在临床中发病率较高,主要由龋病、楔状缺损和外伤导致,临床治疗以复合树脂充填和全冠修复为主,通常根据缺损部位及面积等选择适宜的修复方式。牙本质粘接材料及技术的发展扩大了粘接修复的适应症,也是良好修复效果的保障。

本研究结果显示,粘接修复治疗后短期内的不良反应主要表现为牙本质敏感和冷、热刺痛。根据牙本质敏感的流体动力学说,能够影响牙本质小管液体流动的因素均会导致牙本质敏感症的发生^[2]。①基牙牙本质性质:釉质发育不良的牙齿在釉质磨损地更快,更易发生牙本质敏感^[3]。②酸蚀操作:混合层厚度会随着酸蚀时间的增加而增加,若酸蚀时间过长,粘接力则会降低,引起术后牙本质敏感^[4]。③牙本质表面润湿程度:牙本质表面过湿时,会导致粘接剂中亲水性和疏水性组分的相态分离,导致粘接剂渗透不良,牙本质封闭性下降,从而引起术后牙敏感的发生^[5]。

表7 二分类Logistic回归多因素模型的参数估计(术后7 d)

Table 7 Parameter estimation of binary Logistic regression multifactor model (7 d after operation)

Variables	β	S.E.	P	OR	95% CI	
					Lower limit	Upper limit
Restoration types(Reference=Wedge-shaped defect)						
Dental caries filling	-0.467	0.166	0.005	0.627	0.453	0.868
Full crowns (fixed partial dentures)	-0.011	0.256	0.966	0.989	0.599	1.633
Trauma defect filling	12.594	343.400	0.971	> 999.999	< 0.001	> 999.999
Tooth preparation depth (Reference=prepared to dentin)						
Pulp capping after pulp exposure	0.959	0.221	< 0.001	2.610	1.694	4.022
Near pulp after preparation	-0.026	0.139	0.851	0.974	0.742	1.278
Prepared to enamel	0.445	0.518	0.391	1.560	0.565	4.309
Treatments of bonding surface (reference=self-etch-resin)						
Dentin conditioner-adhesive-resin	-0.388	0.161	0.016	0.679	0.495	0.930
Constant	4.117	0.162	< 0.001			

The results of collinearity diagnostics show that the tolerance is much greater than 0.1, and the variance inflation factor is less than 10, so there is no multicollinearity among the independent variables

表8 二分类Logistic回归多因素模型的参数估计(术后3个月)

Table 8 Parameter estimation of binary Logistic regression multifactor model (3 months after operation)

Variables	β	S.E.	P	OR	95% CI	
					Lower limit	Upper limit
Restoration types (reference = wedge-shaped defect)						
Dental caries filling	0.219	0.448	0.626	1.244	0.517	2.996
Full crowns (fixed partial dentures)	-1.097	0.550	0.046	0.334	0.114	0.980
Trauma defect filling	12.719	952.900	0.989	> 999.999	< 0.001	> 999.999
Treatments of bonding surface (reference = self-etch-resin)						
Dentin conditioner-adhesive-resin	-1.340	0.420	0.001	0.262	0.115	0.596
Constant	6.394	0.420	< 0.001			

The results of collinearity diagnostics show that the tolerance is much greater than 0.1, and the variance inflation factor is less than 10, so there is no multicollinearity among the independent variables

本研究表明,粘接修复治疗后长期的不良反应主要表现为继发龋和修复体脱落。影响粘接后继发龋产生的因素有:原发龋坏未去尽、修复体边缘位置不当、粘接剂溶解、修复体边缘设计不密合、粘接剂种类等。发生在粘接界面牙体组织上的龋损多由微渗漏引起,牙体与充填体间大于50 μm 的裂隙容易导致继发龋的发生。选择线性膨胀系数与牙体组织接近的充填材料,可减小微裂隙^[6]。另外,水的长期作用可导致混合层内胶原纤维和树脂降解,使纳米渗漏孔隙扩大,口腔内液体及细菌等进入^[7]。玻璃离子粘接剂在粘接固化过程中具有抑菌作用,可以释放出氟化物,且线性膨胀系数与牙体组织接近,因而是修复体边缘继发龋易感患者的首选。

修复体松动脱落一般有两方面原因,一为粘接界面粘接力不足,二为修复体受外力过大。在

临床实际中,两者可能同时存在,与牙本质粘接剂相关的为前者。影响修复体粘接强度的因素有:①粘接剂耐久性,变形链球菌中的酯酶会使树脂材料降解^[8],湿润环境下粘接树脂的水解和胶原纤维的酶解也会导致混合层降解,粘接耐久性下降^[9];②修复体弹性模量,应力作用于弹性模量较低的材料时,粘接剂层产生较高的剪应力,可能致使牙冠脱落^[10];③唾液、血液污染,牙本质粘接过程中的唾液、血液污染会导致粘接强度下降^[11-12];④酸蚀时间不当,有研究对比了4种粘接系统,在酸蚀粘接面15 s时均取得高的牙本质粘接强,可通过合理控制粘接面酸蚀时间减少纳米渗漏^[13];⑤粘接剂厚度,适宜的粘接剂厚度可以改善咀嚼负荷下的应力分布,获得较高的粘接强度^[14];⑥患者的饮食习惯,碳酸饮料酸蚀的牙本质在粘接过程中混合层形成不足,影响粘接强度^[15];⑦修

复体表面处理,研究表明使用Er:YAG激光处理深层牙本质,可提高自酸蚀粘接强度^[16],然而Er:YAG激光蚀刻牙本质表面的有效性仍存在争议^[17],低温等离子处理可显著提高氧化锆与树脂水门汀的粘接强度^[18]。

本研究结果显示,不同的年龄和性别、吸烟史和过敏史,以及基牙牙髓状况对疗效无显著影响。不同牙体预备层次中,预备穿髓后盖髓的不良反应发生率最高。穿髓后,口腔中的细菌侵入牙髓,通过释放内毒素、酶、吲哚和有机酸等代谢产物对牙髓造成直接伤害^[19];也可通过引发机体免疫炎症反应间接地导致牙髓损伤^[20]。活髓牙牙髓活力尚存,若备牙量过多,牙髓易受到外界机械、化学、温度因素刺激,诱发牙髓炎,因此在修复时应根据基牙情况决定磨除量,尽可能地保留健康的牙体组织,避免穿髓。全冠修复时,应根据牙体解剖形态,合理设计修复体外形及颈缘位置^[21]。

结合本研究结果及相关原因分析,笔者提出以下临床操作建议及注意事项:①遗留的龋坏、感染的牙体组织可能使病变继续扩展,还可能对牙髓形成持续感染,因此需要去除病变组织,特别是位于釉质牙本质界部位的腐质;②为保证粘接强度、避免微渗漏,洞缘1 mm范围内需预备至正常牙体组织;③对于近髓的龋损,为防止露髓可以采取分期去腐的办法,也可尝试保留少量软化牙本质,通过间接盖髓剂使之再矿化,如有此类情形,需在病历中记录,并安排复诊,以观察临床变化,复查时若发现临床症状或病变加重,则需采取相应措施;④固位形和抗力形需重点考虑,增加粘接面积可以增加固位力;辅助机械固位形有助于增加固位力,临床上需要平衡切割与保留正常组织的得失;在承受咬合的部位需适当增加复合树脂或冠修复材料的厚度,以防止材料折断;对于根管治疗后的后牙,应采用覆盖牙尖的修复方法;⑤使用树脂水门汀粘固氧化锆陶瓷修复体时,应当对粘接面进行喷砂处理,冲洗吹干后涂专用底涂剂;⑥瓷修复体的试戴应当在酸蚀和硅烷处理前进行,以免处理面被污染;⑦为防止龈沟液的渗出和水门汀渗入龈沟内,粘接时最好使用橡皮障和排龈线。

综上所述,树脂水门汀类牙本质粘接剂在复合树脂直接修复和全冠修复的粘接中表现出了良好的性能,但存在一些不良反应。预备层次及粘接面处理方式可能影响不良反应的发生,牙体预

备穿髓后盖髓易导致不良反应发生,牙本质粘接面进行预处理则为保护因素。在行深龋、较深楔状缺损及外伤缺损患牙修复时应更加注意避免牙体预备时穿髓,避免不良反应的发生。

【Author contributions】 Fu XL processed the research, analyzed the data, and wrote the article. Sun JY and Zhu ZL processed the research and collected the data. Gan XQ designed the study and reviewed the article. All authors read and approved the final manuscript as submitted.

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(编辑 周春华, 邵龙泉)



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