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· 基础研究 ·

不同椅旁抛光系统对聚醚醚酮抛光效果的比较

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【摘要】　目的　比较不同成分椅旁抛光系统对不同聚醚醚酮(polyetheretherketone，PEEK)材料的抛光效果，以期为临床合理选择PEEK材料抛光系统提供参考。**方法**　使用舒适捷™ PEEK冠桥材料、Bio-PAEK®牙科PEEK材料、BioHPP® PEEK材料各制作36个试件，共108个试件，每种材料试件随机分为6组，每组6个试件，分别用OptiDisc®、Super-Snap® Rainbow Technique Kit、VITA ENAMIC® Polishing Set clinical、Sof-Lex™ Diamond Polishing System、Visio.lign Finishing Kit for Composite Veneers和CERAMAGE Polishing Kit进行抛光，对照组选用Lava™ Ultimate树脂基陶瓷和VITA ENAMIC®树脂基陶瓷分别制作6个试件，对应使用各自配套的抛光系统Sof-Lex™ Diamond Polishing System及VITA ENAMIC® Polishing Set clinical进行抛光。测量每组试件抛光后的表面粗糙度(Ra值和Sa值)和光泽度，扫描电镜观察抛光后试件表面形貌。**结果**　材料表面粗糙度(Ra值和Sa值)及光泽度主要受抛光系统类型影响，在不同PEEK材料种类间也有差异。Sof-Lex™ Diamond Polishing System抛光PEEK材料所得的表面粗糙度最高，光泽度最低；Super-Snap® Rainbow Technique Kit、Visio.lign Finishing Kit for Composite Veneers及CERAMAGE Polishing Kit抛光PEEK材料所得表面粗糙度较低，Visio.lign Finishing Kit for Composite Veneers及CERAMAGE Polishing Kit抛光PEEK材料所得光泽度较高。Visio.lign Finishing Kit for Composite Veneers抛光PEEK材料后，材料表面可观察到抛光膏颗粒嵌入，而CERAMAGE Polishing Kit抛光组材料表面光滑，未见抛光膏颗粒残留。使用相同抛光系统，受试的PEEK材料中BioHPP®获得的抛光效果最佳。经CERAMAGE Polishing Kit抛光后的3种PEEK材料，表面粗糙度与Lava™ Ultimate树脂基陶瓷及VITA ENAMIC®树脂基陶瓷相当，光泽度则高于两者。**结论**　使用CERAMAGE Polishing Kit抛光3种PEEK材料，均可获得良好的抛光效果，其表面粗糙度与抛光后的计算机辅助设计和制造(computer-aided design and manufacturing，CAD/CAM)树脂基陶瓷接近，且光泽度更高。

【关键词】　聚醚醚酮；　树脂基陶瓷；　椅旁；　抛光；　抛光膏；　表面粗糙度；　光泽度；　扫描电镜

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Comparison of the polishing effects of polyetheretherketone materials under different chairside polishing systems

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【Abstract】 **Objective** The polishing effects of different compositions of chairside polishing systems on polyetheretherketone (PEEK) were compared to provide a reference for the rational selection of polishing systems for this material in clinical settings. **Methods** A total of 108 specimens were made from Shushijie™PEEK crown and bridge materials, Bio-PAEK® dental PEEK, and BioHPP® PEEK. Thirty-six specimens of each material were randomly divided into 6 groups on average based on their polishing technique: OptiDisc®, Super-Snap® Rainbow Technique Kit, VITA ENAMIC®Clinical Polishing Set, Sof-Lex™ Diamond Polishing System, Visio.lign Finishing Kit for Composite Veneers, and CERAMAGE Polishing Kit, Lava™ Ultimate ceramic and VITA ENAMIC ceramics were set as the control groups, and 6 specimens were made in each material, polished by Sof-Lex™ Diamond Polishing System and VITA ENAMIC® Polishing Set clinical, respectively, according to the manufacturers' suggestions. The surface roughness (Ra value and Sa value) and gloss of each set were measured. The surface morphologies of the polished specimens were observed by scanning electron microscopy. **Results** Surface roughness (Ra value and Sa value) and gloss were mainly influenced by the type of polishing system, and they varied between PEEK material types. The Sof-Lex™ Diamond Polishing System produced the highest surface roughness and the lowest gloss values for PEEK materials, while the Super-Snap® Rainbow Technique Kit, Visio.lign Finishing Kit for Composite Veneers and CERAMAGE Polishing Kit resulted in low surface roughness values. The Visio.lign Finishing Kit for Composite Veneers and CERAMAGE Polishing Kit exhibited high gloss values. Polishing paste particles were observed embedded on the surfaces of the PEEK materials polished by the Visio.lign Finishing Kit for Composite Veneers; the surfaces of specimens polished by the CERAMAGE Polishing Kit were smooth, without polishing paste particle residue. Using the same polishing system, the best polishing results were obtained with BioHPP® among the PEEK materials tested. The surface roughness values of the three tested PEEK materials polished by the CERAMAGE Polishing Kit were similar to those of the Lava™ Ultimate ceramic and VITA ENAMIC ceramic, but the gloss was higher than that of both. **Conclusion** CERAMAGE Polishing Kit was recommended for polishing all three tested PEEK materials, achieving a good polishing effect, with similar surface roughness and higher gloss characteristics comparable to those of polished computer-aided design and manufacturing (CAD/CAM) resin-matrix ceramics.

【Key words】 polyetheretherketone; resin-matrix ceramic; chairside; polishing; polishing paste; surface roughness; gloss; scanning electron microscopy

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聚醚醚酮（polyetheretherketone，PEEK）是聚芳醚酮家族中的一类热塑性聚合物，因其具有良好的生物相容性，优良的机械性能，低密度、耐腐蚀、耐磨损等优点，在口腔医学领域应用日益广泛[1]。当PEEK用于固定义齿、可摘局部义齿支架、殆垫或牙周夹板等修复治疗时[2-7]，椅旁调改后的精细抛光极为必要，有助于提高修复体光泽度，降低其表面粗糙度和细菌黏附[8-9]，延长修复体使用寿命，并减少对对殆牙的磨损[10-11]。目前实验研究以及临床实际应用中常将树脂抛光材料用于PEEK的表面抛光[12-15]，但关于不同成分抛光材料对PEEK抛光效果的对比研究鲜有报道，因而本研究拟以计算机辅助设计和制造（computer-aided design and manufacturing，CAD/CAM）树脂基陶瓷为对照，探讨不同椅旁抛光系统对不同类型PEEK材料表面性能的影响，以期为PEEK椅旁抛光材料的选择及应用提供临床指导。

1 材料和方法

1.1 材料和仪器

1.1.1 材料　如表1所示，实验材料有3种：舒适捷™ PEEK冠桥材料（运怡，中国）；Bio-PAEK®牙科PEEK材料（登泰克，中国）；BioHPP® PEEK材料（Bredent，德国）；使用Lava™ Ultimate树脂基陶瓷（3M ESPE，美国）和VITA ENAMIC®树脂基陶瓷（VITA，德国）作为对照。

1.1.2　抛光系统　如表2所示，实验材料对应的抛光系统：OptiDisc®（Kerr，美国）；Super-Snap® Rainbow Technique Kit（SHOFU，日本）；VITA ENAMIC® Polishing Set clinical（Vita，德国）；Sof-Lex™ Diamond Polishing System（3M，美国）；Visio.lign Finishing Kit for Composite Veneers（Bredent，德国）；CERAMAGE Polishing Kit（SHOFU，日本）；对照材料Lava™ Ultimate树脂基陶瓷和VITA ENAMIC®树脂基陶瓷分别配套用的抛光系统为：Sof-Lex™ Diamond Polishing System（3M，美国）；VITA ENAMIC® Polishing Set clinical（Vita，德国）。

设备：切削智能一体机（Ceramill Matik，AMANN GIRRBACH，德国）；慢速切片机（SYJ-150A，沈阳科晶自动化设备制造有限公司，中国）；电热鼓风干燥箱（WGL-45B，天津市泰斯特仪器有限公司，中国）；三维表面形貌仪（PS50，NANOVEA，

表1　5种实验材料的基本情况

Table 1　General information of five kinds of experimental materials

Material groups	Brand	Material matrix	Main components of fillers	Filler mass fraction	Manufacturer
S	Shushijie™	PEEK	\	\	YunMed, China
BP	BioPAEK®	PEEK	TiO_2	5%	DENTEX, China
BH	BioHPP®	PEEK	Ceramic	20%	Bredent, Germany
LU	Lava™ Ultimate	Bis-GMA, UDMA, Bis-EMA, TEGDMA	Non-agglomerated SiO_2 (20 nm) and ZrO_2 (4-11 nm), and SiO_2/ZrO_2 Nano-agglomerates	80%	3M, USA
VE	VITA ENAMIC®	UDMA, TEGDMA	Alumina reinforced feldspathic porcelain: SiO_2 (58%-63%), Al_2O_3(20%-23%), Na_2O (6%-11%), K_2O (4%-6%), B_2O_3 (0.5%-2%), CaO (<1%), TiO_2 (<1%)	86%	VITA, Germany

Bis-GMA: bisphenol A-glycidyl methacrylate; UDMA: urethane dimethacrylate; Bis-EMA: bisphenol A-ethoxylated dimethacrylate; TEGDMA: triethyleneglycoldimethacrylate. Material groups: S: Shushijie™; BP: BioPAEK®; BH: BioHPP®; LU: Lava™ Ultimate; VE: VITA ENAMIC®. PEEK: polyetheretherketone. S, BP, BH were as for experimental groups. LU, VE were as for control groups

表2　6种抛光系统的基本信息

Table 2　Information of the six tested polishing systems

Polishing systems	Brand	Manufacturer	Composition	Polishing protocol
O	OptiDisc®	Kerr, USA	Alumina particles	①Polishing (orange): ≤ 15 000 r/min ②High luster polishing (yellow): ≤ 15 000 r/min
SS	Super-Snap® Rainbow Technique Kit	SHOFU, Japan	Alumina particles	①Polishing (green): ≤ 15 000 r/min ②High luster polishing (pink): ≤ 15 000 r/min
V	VITA ENAMIC® Polishing Set clinical	VITA, Germany	Polyurethane, silicon carbide, diamond particles	①Polishing (pink): ≤ 10 000 r/min ②High luster polishing (grey): ≤ 8 000 r/min
SL	Sof-Lex™ Diamond Polishing System	3M, USA	Rubber, alumina, diamond particles	Polishing (pink): ≤ 20 000 r/min, apply 30-60 g force, wet polishing
VL	Visio.lign Finishing Kit for Composite Veneers	Bredent, Germany	Silicone rubber, cotton buff, diamond particles	①Smoothing: rubber polisher (blue) ②High luster polishing: ≤ 3 000 r/min, cotton buff with cream Abraso-Starglanz high-gloss polishing paste containing diamond particles
C	CERAMAGE Polishing Kit	SHOFU, Japan	Silicone rubber, wool felt, Dura-Polish: alumina (73% by weight), Dura-Polish DIA: diamond particles (67% by weight).	①Polishing: ≤ 10 000 r/min, brush with waxy polishing paste containing alumina and diamond particles respectively ②High luster polishing: ≤ 10 000 r/min with wool wheel

Polishing systems: O: OptiDisc®; SS: Super-Snap® Rainbow Technique Kit; V: VITA ENAMIC® Polishing Set clinical; SL: Sof-Lex™ Diamond Polishing System; VL: Visio.lign Finishing Kit for Composite Veneers; C: CERAMAGE Polishing Kit. O, SS, V, SL, VL, C were as for experimental materials. V, SL were as for control materials

美国)；场发射扫描电子显微镜(S-4800，Hitachi，日本)；原子力显微镜(5500，Keysight，美国)；光泽度仪(NHG60M，深圳市三恩时科技有限公司，中国)。

1.2 实验方法

1.2.1 试件制作 分别将舒适捷™ PEEK冠桥材料、Bio-PAEK®牙科PEEK材料、BioHPP® PEEK材料3种预压成型的PEEK盘以及Lava™ Ultimate和VITA ENAMIC® 2种CAD/CAM树脂基陶瓷块用五轴铣削机切削成直径8 mm、高11 mm的圆柱，用低速切割机在冷水冷却下将其再切割成直径为8 mm、高3 mm的小圆柱形试件，每种PEEK材料取36个试件，CAD/CAM树脂基陶瓷材料取6个试件，用800目砂纸打磨进行标准化处理，随后超纯水超声清洗10 min，室温干燥备用。

1.2.2 试件分组和抛光 将每种PEEK材料的36个试件随机分为6组，每组6个，分别使用6种受试的抛光系统抛光，两种树脂基陶瓷试件分别用其对应同品牌抛光系统进行抛光。每种材料的具体抛光步骤见表2，全部抛光过程由同一个研究者完成。

1.2.3 粗糙度及光泽度测定 使用三维表面形貌仪对标准化后、抛光后试件表面进行粗糙度测定，以线粗糙度Ra为测量指标，测量每个试件中心2 mm × 2 mm区域，扫描步径X/Y设置为10 μm/s。使用原子力显微镜轻敲式模式测试，以面粗糙度Sa为测量指标，每个试件测量20 μm × 20 μm区域。采用光泽度仪测定标准化后、抛光后试件表面光泽度，测量角度60°，每次测量前采用标准板校准，每个试件测量3次，取平均值作为此试件表面光泽度值。

1.2.4 表面形貌观察 每个抛光组随机选取1个试件，超纯水超声清洗5 min，室温干燥，表面喷金，在扫描电子显微镜(scanning electron microscopy，SEM)下观察试件表面微观形貌，工作电压5.0 kV，放大倍数为400倍。

1.3 统计学分析

应用SPSS26.0进行数据分析，数据符合正态分布，采用双因素析因设计方差分析检验PEEK材料和抛光系统对材料表面性能的影响，不同PEEK材料、不同抛光系统之间的差异用单因素方差分析。方差齐性者采用Beforroni进行两两分析比较；方差不齐者，采用Tamhane's T2进行两两分析比较。双侧检验水准为α=0.05。

2 结 果

2.1 表面粗糙度

2.1.1 三维表面形貌仪测得表面粗糙度Ra值 如表3、图1所示，双因素方差分析结果证实，不同抛光系统抛光后试件的表面粗糙度Ra值间差异有统计学意义(F = 58.80，P < 0.001)，不同PEEK材料间差异有统计学意义(F = 5.54，P < 0.001)，且两者存在交互作用(F = 6.58，P < 0.001)。

单因素方差分析组内两两比较显示，同种PEEK材料6种抛光系统之间Ra值差异有统计学意义(P < 0.001)。三种PEEK材料的SL组Ra值都显著高于其余各组(P < 0.001)。对于舒适捷™ PEEK冠桥材料，O组抛光系统Ra值显著高于除SL组外其他各组(P < 0.01)，VL组显著低于除C组外其余各组(P < 0.05)；对于Bio-PAEK®牙科PEEK材料，C组、VL组抛光系统Ra值显著低于其余各组(P < 0.05)，O组抛光系统Ra值显著高于除SL组外其余各组(P < 0.05)；对于BioHPP® PEEK材料，VL组及C组抛光系统Ra值显著低于其他各组(P < 0.001)，O组、SS组、V组抛光系统Ra值组间差异无统计学意义(P > 0.05)，VL及C组抛光系统Ra值组间差异无统计学意义(P > 0.05)。

同一种抛光系统下，O组抛光后，BioHPP® PEEK材料Ra值显著低于舒适捷™ PEEK冠桥材料的Ra值(P < 0.001)；SS组抛光后各组材料间Ra值差异无统计学意义(P > 0.05)；V组抛光后，VITA ENAMIC®树脂基陶瓷材料Ra值显著低于PEEK材料(P < 0.05)；SL组抛光后，舒适捷™ PEEK冠桥材料Ra值显著高于其余两组PEEK材料及Lava™ Ultimate树脂基陶瓷材料，Bio-PAEK®牙科PEEK材料Ra值显著高于Lava™ Ultimate树脂基陶瓷材料；VL组抛光后，Bio-PAEK®牙科PEEK材料Ra值显著高于其余两种PEEK材料(P < 0.05)；C组抛光后，舒适捷™ PEEK冠桥材料Ra值显著高于BioHPP® PEEK材料(P < 0.05)。

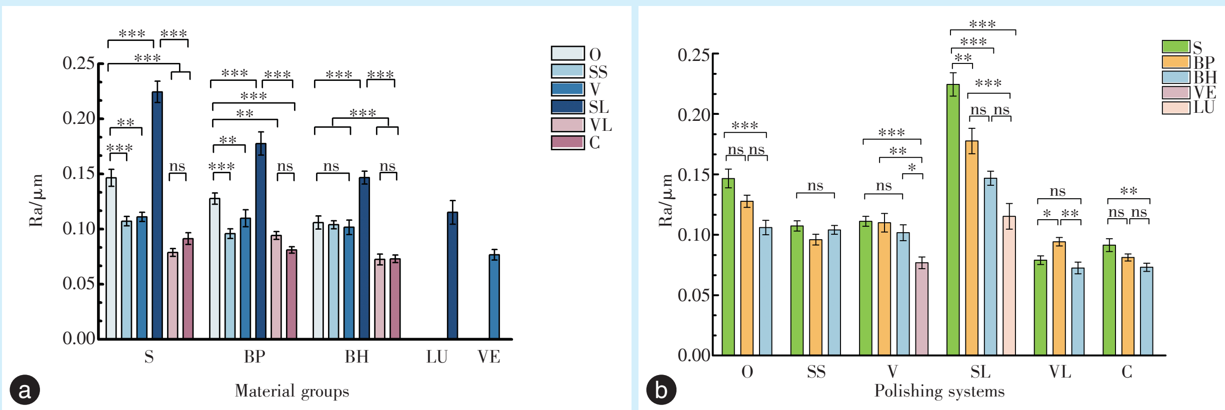
2.1.2 原子力显微镜测得表面粗糙度Sa值 Sa值普遍较Ra值偏小，而整体趋势与Ra值近似(表4、图2)。双因素方差分析结果证实，与Ra值结果类似，不同抛光系统抛光后试件的表面粗糙度Sa值间差异存在统计学意义(F = 39.77，P < 0.001)，但不同PEEK材料间差异无统计学意义(F = 1.880，P = 0.072)，两者存在交互作用(F = 28.01，P <

表 3　各组抛光后三维表面形貌仪测得表面粗糙度 Ra 值

Table 3　Surface roughness (Ra value) of each group was measured by a 3D surface profiler after polishing　$\bar{x} \pm s$, μm

Material group	Baseline	Polishing system O	SS	V	SL	VL	C	Mean ± SD	*F*	*P*
S	0.267 ± 0.012	0.147 ± 0.033	0.107 ± 0.018	0.111 ± 0.017	0.225 ± 0.041	0.079 ± 0.015	0.091 ± 0.022	0.127 ± 0.055	74.103	< 0.001
BP	0.261 ± 0.007	0.128 ± 0.022	0.096 ± 0.019	0.110 ± 0.033	0.175 ± 0.044	0.094 ± 0.015	0.081 ± 0.012	0.113 ± 0.040	28.616	< 0.001
BH	0.259 ± 0.007	0.106 ± 0.025	0.104 ± 0.016	0.102 ± 0.028	0.147 ± 0.025	0.073 ± 0.021	0.073 ± 0.014	0.101 ± 0.033	27.835	< 0.001
LU	0.218 ± 0.006				0.115 ± 0.045			0.115 ± 0.045		
VE	0.224 ± 0.009			0.077 ± 0.021				0.077 ± 0.021		
Mean ± SD	0.258 ± 0.016	0.127 ± 0.031	0.102 ± 0.018	0.100 ± 0.028	0.165 ± 0.056	0.082 ± 0.019	0.082 ± 0.018	0.112 ± 0.045	58.80	< 0.001
F		10.167	2.014	7.129	24.749	7.705	5.290	5.540	6.580	< 0.001
P		< 0.001	0.144	< 0.001	< 0.001	0.001	0.008	< 0.001	< 0.001	

Material groups: S: Shushijie™; BP: BioPAEK®; BH: BioHPP®; LU: Lava™ Ultimate; VE: VITA ENAMIC®. S, BP, BH were as for experimental groups. LU, VE were as for control groups. Polishing systems: O: OptiDisc®; SS: Super-Snap® Rainbow Technique Kit; V: VITA ENAMIC® Polishing Set clinical; SL: Sof-Lex™ Diamond Polishing System; VL: Visio.lign Finishing Kit for Composite Veneers; C: CERAMAGE Polishing Kit. O, SS, V, SL, VL, C were as for experimental materials. V, SL were as for control materials



a: surface roughness (Ra value) of the same PEEK materials with different polishing systems. b: surface roughness (Ra value) of different PEEK materials with the same polishing system. Material groups: S: Shushijie™; BP: BioPAEK®; BH: BioHPP®; LU: Lava™ Ultimate; VE: VITA ENAMIC®. S, BP, BH were as for experimental groups. LU, VE were as for control groups. Polishing systems: O: OptiDisc®; SS: Super-Snap® Rainbow Technique Kit; V: VITA ENAMIC® Polishing Set clinical; SL: Sof-Lex™ Diamond Polishing System; VL: Visio.lign Finishing Kit for Composite Veneers; C: CERAMAGE Polishing Kit. O, SS, V, SL, VL, C were as for experimental materials. V, SL were as for control materials. *: $P < 0.05$.**: $P < 0.01$.***: $P < 0.001$. ns: no statistically significant difference. PEEK: polyetheretherketone

Figure 1　Surface roughness (Ra value) of PEEK materials in the experimental group and materials in the control group under different polishing systems

图 1　实验组 PEEK 材料和对照组材料采用不同抛光系统后表面粗糙度 Ra 值

0.001）。

单因素方差分析组内两两比较显示，舒适捷™ PEEK 冠桥材料及 Bio-PAEK®牙科 PEEK 材料的 6 种抛光系统之间 Sa 值差异有统计学意义（$P < 0.05$），BioHPP® PEEK 材料的 6 种抛光系统之间 Sa 值差异无统计学意义（$P > 0.05$）。对于舒适捷™ PEEK 冠桥材料和 Bio-PAEK®牙科 PEEK 材料，SL 组抛光系统 Sa 值显著高于 SS 组、V 组、VL 组、C 组（$P < 0.05$），其余 5 组抛光系统之间 Sa 值差异无统计学意义（$P > 0.05$）。

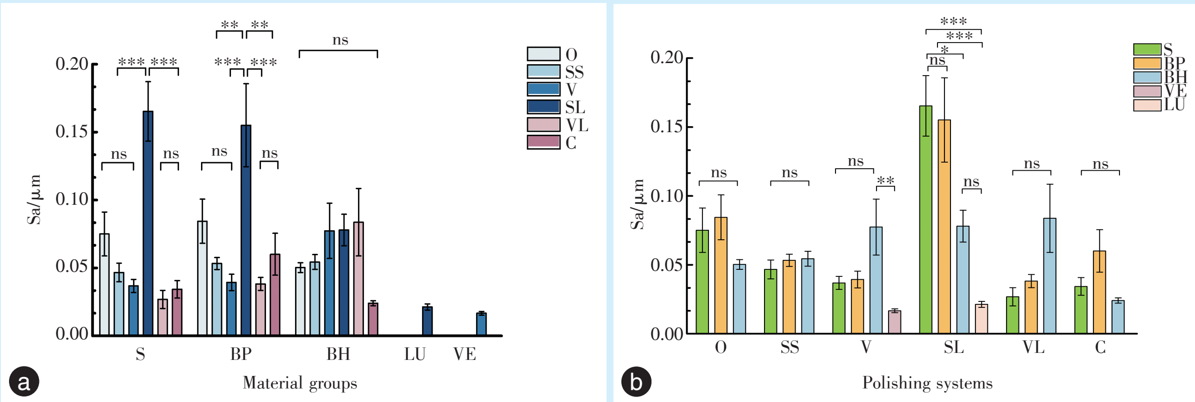
同一种抛光系统下，O 组、SS 组、VL 组及 C 组抛光后各组材料间 Sa 值差异无统计学意义（$P > 0.05$），V 组抛光后，BioHPP® PEEK 材料 Sa 值显著高于 VITA ENAMIC®树脂基陶瓷材料（$P < 0.05$）；SL 组抛光后，除 Bio-PAEK®牙科 PEEK 材料与舒适捷™ PEEK 冠桥材料、BioHPP® PEEK 材料与 Lava™ Ultimate 树脂基陶瓷材料 Sa 值组间差异无统计学意义外（$P > 0.05$），其余材料组 Sa 值差异有统计学

表4　各组抛光后原子力显微镜测得表面粗糙度Sa值

Table 4　Surface roughness (Sa value) of each group was measured by atomic force microscope after polishing　$\bar{x} \pm s$, μm

Material groups	Polishing systems						Mean ± SD	F	P
	O	SS	V	SL	VL	C			
S	0.075 ± 0.039	0.047 ± 0.017	0.037 ± 0.012	0.165 ± 0.054	0.027 ± 0.149	0.034 ± 0.016	0.065 ± 0.056	7.219	0.002
BP	0.084 ± 0.040	0.053 ± 0.011	0.039 ± 0.015	0.155 ± 0.075	0.038 ± 0.117	0.060 ± 0.038	0.072 ± 0.055	4.247	0.015
BH	0.050 ± 0.009	0.054 ± 0.121	0.077 ± 0.050	0.078 ± 0.028	0.084 ± 0.061	0.024 ± 0.005	0.062 ± 0.039	2.513	0.052
LU				0.021 ± 0.005			0.021 ± 0.005		
VE			0.017 ± 0.003				0.017 ± 0.003		
Mean ± SD	0.070 ± 0.034	0.051 ± 0.013	0.043 ± 0.033	0.105 ± 0.075	0.051 ± 0.044	0.040 ± 0.027	0.061 ± 0.050	39.77	< 0.001
F	1.747	0.547	10.600	11.879	2.682	3.448	1.880	28.01	< 0.001
P	0.208	0.591	0.003	<0.001	0.127	0.088	0.072	< 0.001	

Material groups: S: Shushijie™; BP: BioPAEK®; BH: BioHPP®; LU: Lava™ Ultimate; VE: VITA ENAMIC®. S, BP, BH were as for experimental groups. LU, VE were as for control groups. Polishing systems: O: OptiDisc®; SS: Super-Snap® Rainbow Technique Kit; V: VITA ENAMIC® Polishing Set clinical; SL: Sof-Lex™ Diamond Polishing System; VL: Visio.lign Finishing Kit for Composite Veneers; C: CERAMAGE Polishing Kit. O, SS, V, SL, VL, C were as for experimental materials. V, SL were as for control materials. PEEK: polyetheretherketone. Due to the large surface roughness (Ra value) after standardization, the measurement of the surface roughness (Sa value) in the baseline was not performed



a: surface roughness (Sa value) of the same PEEK material with different polishing systems. b: surface roughness (Sa) of different PEEK materials with the same polishing system. Material groups: S: Shushijie™; BP: BioPAEK®; BH: BioHPP®; LU: Lava™ Ultimate; VE: VITA ENAMIC®. S, BP, BH were as for experimental groups. LU, VE were as for control groups. Polishing systems: O: OptiDisc®; SS: Super-Snap® Rainbow Technique Kit; V: VITA ENAMIC® Polishing Set clinical; SL: Sof-Lex™ Diamond Polishing System; VL: Visio.lign Finishing Kit for Composite Veneers; C: CERAMAGE Polishing Kit. O, SS, V, SL, VL, C were as for experimental materials. V, SL were as for control materials. *: $P < 0.05$. **: $P < 0.01$. ***: $P < 0.001$. ns: no statistically significant difference. PEEK: polyetheretherketone

Figure 2　Surface roughness (Sa value) of PEEK materials in the experimental group and materials in the control group under different polishing systems

图2　实验组PEEK材料和对照组材料采用不同抛光系统后表面粗糙度Sa值

意义（$P < 0.05$）。

2.2　表面光泽度

如表5、图3所示，双因素方差分析结果证实，不同抛光系统抛光试件后光泽度差异具有统计学意义（$F = 81.48$，$P < 0.001$），不同PEEK材料间差异无统计学意义（$F = 0.11$，$P = 0.610$），两者存在交互作用（$F = 8.10$，$P < 0.001$）。

单因素方差分析组内两两比较证实，同种PEEK材料6种抛光系统之间光泽度差异有统计学意义（$P < 0.05$）。在3组PEEK材料中，SL组光泽度低于其余各抛光组（$P < 0.05$）。对于舒适捷™ PEEK冠桥材料，O组、VL组及C组抛光系统光泽度显著高于SS组、V组（$P < 0.05$）；对于Bio-PAEK®牙科PEEK材料，V组、VL组及C组抛光系统光泽度显著高于O组、SS组；对于BioHPP® PEEK材料，VL组及C组抛光系统光泽度显著高于O组、SS组、

V组($P < 0.05$);O组、SS组及V组3组间光泽度差异无统计学意义($P > 0.05$)。

同一种抛光系统下,SS组、C组抛光后各组材料间光泽度差异无统计学意义($P > 0.05$);O组抛光后,舒适捷™ PEEK冠桥材料光泽度显著高于其余两种PEEK材料($P < 0.01$);V组抛光后,Bio-PAEK®牙科PEEK材料、舒适捷™ PEEK冠桥材料光泽度显著高于BioHPP® PEEK材料($P < 0.01$),Bio-PAEK®牙科PEEK材料光泽度显著高于VITA ENAMIC®树脂基陶瓷材料($P < 0.001$);SL组抛光后,Lava™ Ultimate树脂基陶瓷光泽度显著高于其余各材料组($P < 0.001$);VL组抛光后,BioHPP® PEEK材料光泽度显著高于Bio-PAEK®牙科PEEK材料($P < 0.05$),舒适捷™ PEEK冠桥材料光泽度与其余两组材料光泽度的差异均无统计学意义($P > 0.05$)。

2.3　表面形貌

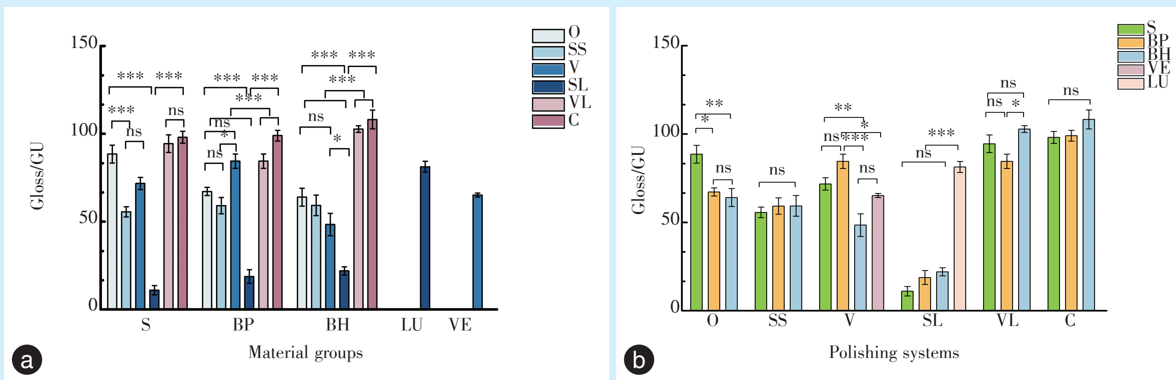
如图4所示,所有试件在SEM下均观察到不同程度的划痕。O组、SS组为明显而不规则交错的划痕;V组在舒适捷™ PEEK冠桥材料和BioHPP®

表5　各组抛光后光泽度

Table 5　Gloss of each group after polishing　　$\bar{x} \pm s$, GU

Material groups	Baseline	Polishing systems						Mean ± SD	F	P
		O	SS	V	SL	VL	C			
S	3.586 ± 0.494	88.54 ± 12.37	55.66 ± 7.27	71.77 ± 8.53	11.06 ± 6.49	94.48 ± 12.25	98.08 ± 8.25	69.93 ± 31.70	72.362	< 0.001
BP	4.235 ± 0.662	67.24 ± 5.63	59.23 ± 11.30	84.51 ± 9.894	18.80 ± 9.57	84.51 ± 9.89	99.05 ± 7.48	68.89 ± 27.53	55.266	0.001
BH	4.232 ± 0.476	64.05 ± 12.41	59.32 ± 14.33	48.44 ± 15.73	22.84 ± 5.17	105.68 ± 4.35	108.23 ± 13.11	67.78 ± 31.73	129.668	< 0.001
LU	13.561 ± 2.176				81.34 ± 7.52					
VE	5.633 ± 1.137			65.18 ± 2.82						
Mean ± SD	4.576 ± 2.242	73.28 ± 14.99	58.07 ± 10.80	67.47 ± 16.40	33.81 ± 9.97	93.41 ± 11.83	101.79 ± 10.45	68.18 ± 29.84	81.48	< 0.001
F		9.426	0.204	9.148	111.955	4.912	1.910	0.11	8.10	< 0.001
P		0.002	0.818	0.004	< 0.001	0.024	0.182	0.6095	< 0.001	

Material groups: S: Shushijie™; BP: BioPAEK®; BH: BioHPP®; LU: Lava™ Ultimate; VE: VITA ENAMIC®. S, BP, BH were as for experimental groups. LU, VE were as for control groups. Polishing systems: O: OptiDisc®; SS: Super-Snap® Rainbow Technique Kit; V: VITA ENAMIC® Polishing Set clinical; SL: Sof-Lex™ Diamond Polishing System; VL: Visio.lign Finishing Kit for Composite Veneers; C: CERAMAGE Polishing Kit. O, SS, V, SL, VL, C were as for experimental materials. V, SL were as for control materials

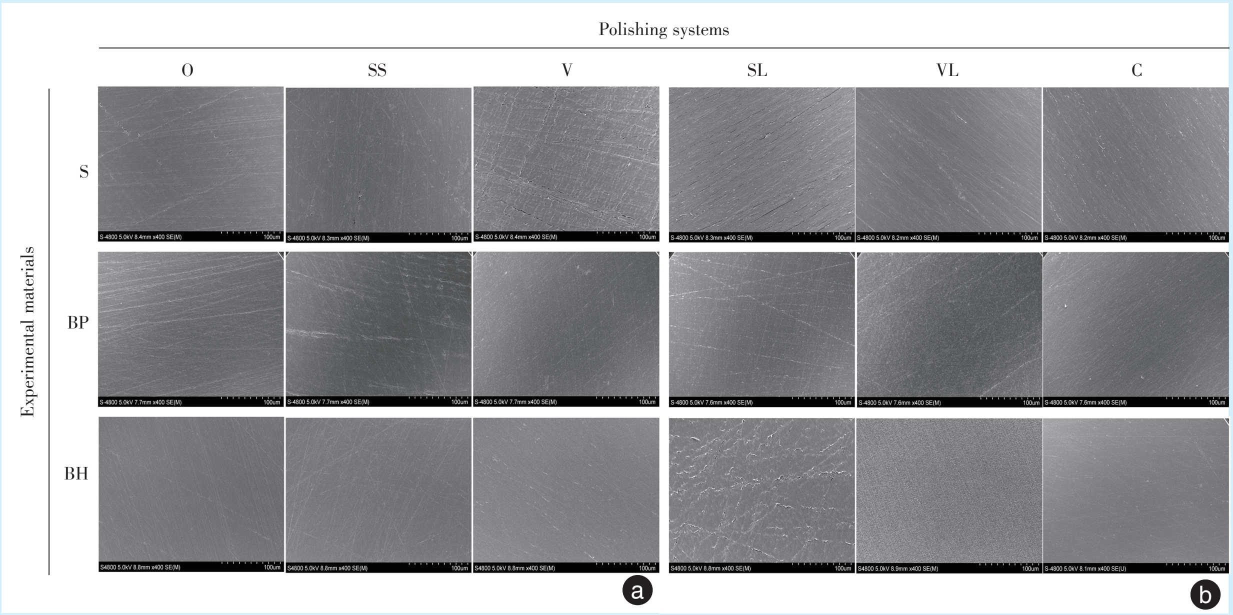


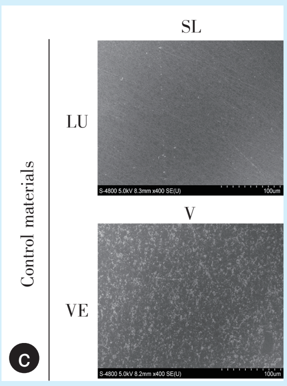
a: gloss of the same PEEK material with different polishing systems. b: gloss of different PEEK materials with the same polishing system. Material groups: S: Shushijie™; BP: BioPAEK®; BH: BioHPP®; LU: Lava™ Ultimate; VE: VITA ENAMIC®. S, BP, BH were as for experimental groups. LU, VE were as for control groups. Polishing systems: O: OptiDisc®; SS: Super-Snap® Rainbow Technique Kit; V: VITA ENAMIC® Polishing Set clinical; SL: Sof-Lex™ Diamond Polishing System; VL: Visio.lign Finishing Kit for Composite Veneers; C: CERAMAGE Polishing Kit. O, SS, V, SL, VL, C were as for experimental materials. V, SL were as for control materials. *: $P < 0.05$. **: $P < 0.01$. ***: $P < 0.001$. ns: no statistically significant difference. PEEK: polyetheretherketone

Figure 3　Gloss of of PEEK materials in the experimental group and materials in the control group under different polishing systems

图3　实验组PEEK材料和对照组材料采用不同抛光系统后光泽度

PEEK材料中可见明显的较深划痕，且划痕不规则；在Bio-PAEK®牙科PEEK材料中划痕较浅，但仍不规则；SL组可见材料表面产生较深沟壑，可见不平整材料碎屑残留；经VL组抛光后，3种PEEK材料表面均可见均匀嵌入材料中的抛光膏颗粒；C组使用氧化铝及含金刚石抛光蜡抛光，3种PEEK材料表面划痕少且细浅，质地较均匀，未见明显抛光膏内颗粒残留。相比于PEEK材料，树脂基陶瓷经抛光后，表面划痕较少，整体光滑而平整。





Scratches of different degrees were observed in all specimens under SEM (a, b, c). a: the obvious irregular scratches can be seen on the surface of the material after polishing by OptiDisc®, Super-Snap® Rainbow Technique Kit and VITA ENAMIC® Polishing system. b: the scratches on the surface of three tested PEEK materials polished by CERAMAGE Polishing Kit were few and shallow, and the texture was uniform, without obvious residual polishing paste particles. Scratches on the surfaces of the specimens after polishing by Sof-Lex™ Diamond Polishing System were deep; polishing paste particles embedded could be seen uniformly on the surface of PEEK specimens polished by Visio.lign Finishing Kit for Composite Veneers. c: the polished resin-matrix ceramics exhibited less scratches on the surface and were smoother. Material groups: S: Shushijie™; BP: BioPAEK®; BH: BioHPP®; LU: Lava™ Ultimate; VE: VITA ENAMIC®. S, BP, BH were as for experimental groups. LU, VE were as for control groups. Polishing systems: O: OptiDisc®; SS: Super-Snap® Rainbow Technique Kit; V: VITA ENAMIC® Polishing Set clinical; SL: Sof-Lex™ Diamond Polishing System; VL: Visio.lign Finishing Kit for Composite Veneers; C: CERAMAGE Polishing Kit. O, SS, V, SL, VL, C were as for experimental materials. V, SL were as for control materials. PEEK: polyetheretherketone. SEM: scanning electron microscope

Figure 4　SEM surface morphologies of PEEK materials in the experimental groups and materials in the control groups under different polishing systems

图4　实验组PEEK材料和对照组材料经不同抛光系统抛光后表面形貌SEM观察

3　讨　论

良好的抛光可以降低修复体表面粗糙度，减少修复体表面细菌黏附。Bollen等[9]研究表明，粗糙度Ra值大于0.2 μm时，随着粗糙度的增加，修复体表面细菌黏附显著增多。因此，修复体表面粗糙度Ra值需小于0.2 μm才能满足临床需要。影响修复材料抛光效果的因素包括修复材料类型，如是否添加填料、填料占比及填料粒径，抛光工具的磨料类型、硬度以及抛光时的转速、接触压力等[16-17]。有研究证实，含纳米陶瓷填料的PEEK材料抛光性能优于不含填料的PEEK材料[16]。类比复合树脂材料，对于含填料的PEEK材料，抛光系统研磨颗粒的硬度必须大于PEEK材料中的填料，才能实现有效的抛光，否则只能去除较软的PEEK基质，而残留的纳米陶瓷及氧化钛填料颗粒会突出于PEEK表面，并将在咀嚼过程中逐渐剥

脱，形成孔洞，从而成为细菌容易附着的部位[18]。本研究选用两种树脂基陶瓷材料作为对照组。其中VE（VITA ENAMIC®）以氧化铝增强的长石质瓷为主要填料，而LU（Lava™ Ultimate）以SiO_2及ZrO_2为主要填料，VE填料多于LU，VE材料硬度更高[19]，且VE及LU材料硬度均高于受试的3种PEEK材料。从粗糙度结果可见，树脂基陶瓷抛光后更易获得较低的粗糙度及较高的光泽度，抛光后表面划痕较少。VE组抛光后表面粗糙度低于LU组试件，表面划痕也较少，而光泽度则是VE组高于LU组。

本研究受试的3种PEEK材料中，Bio-PAEK®及BioHPP®分别含纳米陶瓷及二氧化钛填料，舒适捷则为不含填料的纯PEEK材料。采用的6种临床常用的椅旁抛光系统包括3种碟状抛光系统（OptiDisc®、Sof-Lex™和Super-Snap®）和3种橡胶磨头抛光系统（VITA ENAMIC®、Visio.lign Finishing Kit for Composite Veneers和CERAMAGE），OptiDisc®和Super-Snap®为临床常用树脂抛光工具，Visio.lign Finishing Kit for Composite Veneers为BioHPP®推荐使用抛光工具，Sof-Lex™和VITA ENAMIC®分别为对应树脂基陶瓷配套的专用抛光工具，CERAMAGE为树脂基陶瓷、陶瓷材料常用抛光工具，选用这6种抛光系统作为实验组，可以较全面地筛选更适合PEEK材料的抛光工具。其中，Visio.lign Finishing Kit for Composite Veneers和CERAMAGE抛光系统中包含抛光膏，Visio.lign Finishing Kit for Composite Veneers抛光系统中的糊状抛光膏含有金刚石颗粒（莫氏硬度10），CERAMAGE抛光系统中的两种蜡状抛光膏分别含氧化铝颗粒（莫氏硬度9）及金刚石颗粒。这6种抛光系统中的磨粒硬度均大于纳米陶瓷填料（莫氏硬度6～8）和二氧化钛填料（莫氏硬度6）的硬度，可以在抛光过程中一并将填料颗粒磨除，形成较为平坦的表面。在经同一抛光系统抛光后，含二氧化钛填料的BioHPP®则更易获得较低粗糙度。

口腔修复体的抛光可采用二体磨料磨损或三体磨料磨损模式抛光系统[20]。在二体磨料磨损模式下，磨粒牢固地固定在抛光工具基体上，即不含抛光膏的抛光模式；在三体磨料磨损模式下，松散磨粒在待抛光试样表面与平面抛光工具间形成浆体，即应用抛光膏的抛光模式。Jefferies等[20]证实，对于亚微米复合树脂材料而言，氧化铝浸渍抛光碟序列抛光后再使用抛光膏是可行的，Heimer等[12]使用含氧化铝的Prisma-gloss抛光膏椅旁抛光PEEK材料（BioHPP®），Kurahashi等[14]用含氧化铵的抛光膏抛光纯PEEK材料（JUVORA Dental Disc）也获得了良好的抛光效果，并认为三体磨料磨损模式的抛光系统抛光后所得表面粗糙度低于二体磨料磨损模式的抛光系统。本研究中，使用VL组（Visio.lign Finishing Kit for Composite Veneers）及C组（CERAMAGE Polishing Kit）抛光系统均能获得较低表面粗糙度，同时SEM结果发现，使用三体磨料磨损型抛光系统时，VL组经Visio.lign Finishing Kit for Composite Veneers抛光系统抛光后，糊状抛光膏均匀嵌入了材料表面，无法清除；而C组经CERAMAGE Polishing Kit抛光系统抛光后，材料表面则显示出较少划痕，未见蜡状抛光膏中的颗粒嵌入，其原因可能与两种抛光系统的分散介质不同相关。因含糊状抛光膏形态较为松散，在抛光刷/轮高速转动及一定施力下，PEEK材料会与抛光颗粒结合，形成与材料基底相连的卷状碎屑，并将抛光颗粒裹入其中，因此抛光PEEK材料时，应慎用含糊状抛光膏的抛光系统 。PEEK为高分子材料，其有机成分占比大，抛光碎屑不易剥脱。相比之下，二体磨料磨损型抛光系统则更便于使用。本实验的三种抛光碟，均含有氧化铝颗粒，氧化铝是抛光碟通过抛光实现光滑表面的最重要组成部分[21]。其中，Super-snap®抛光碟更易操作，在材料上产生的划痕较小；OptiDisc®抛光碟由于碟型较薄且硬，会产生较多不可控划痕；而Sof-Lex®抛光碟较硬且无法贴合试件，难以产生平坦表面。VITA ENAMIC®抛光系统有3种不同形状抛光磨头，可应对不同形状抛光区域，但其硬度高于PEEK材料，也易在抛光过程中产生划痕。

光泽度是评估抛光后美学效果的一项重要指标[22]。Mörmann等[23]测得，釉质经抛光所得的光泽度约为53 GU, Costa等[24]认为复合树脂材料的光泽度在50 GU以上被认为是临床可接受的，Melo等[25]认为光泽度在55 GU以上可认为材料得到了良好的抛光。对比本研究的光泽度测试结果，3种受试的PEEK材料经O组、VL组、C组抛光系统抛光后表面光泽度均高于60 GU，其中，C组抛光后光泽度最高（均高于95 GU）。

本研究采用三维表面形貌仪和原子力显微镜，分别以非接触模式和敲击模式测量抛光后试件的Ra值及Sa值，Ra为线粗糙度，Sa则为线粗糙度Ra扩展延伸而来的面粗糙度。有研究显示，与

Ra值相比，Sa值与光泽度值的相关性更高，更适合区分表面粗糙度[26]。而在本实验中，结合光泽度数据可见，Ra值变化趋势更符合光泽度值变化趋势，可能原因为三维表面形貌仪扫描区域大，代表性更佳。因此，可认为Ra值更能代表本实验抛光效果，而其与微观细菌黏附情况的相关性如何，则需进一步研究。本研究的不足之处则是由于试件标化后表面粗糙度（Ra）较大，并未进行原子力显微镜的表面粗糙度（Sa）的测量。

本项研究结果提示：推荐使用CERAMAGE Polishing Kit抛光3种PEEK材料，可获得较低的表面粗糙度、较少的表面划痕及较高的光泽度。其中，含二氧化钛填料的BioHPP®材料抛光效果更好。在使用CERAMAGE Polishing Kit中的抛光蜡时，应避免施力过大及转速过快，以防止蜡状抛光膏中的颗粒嵌入PEEK材料；使用抛光碟抛光PEEK亦可达到降低PEEK表面粗糙度、提高光泽度的目的，且使用方便，避免了抛光过程中的抛光膏飞溅；Sof-Lex™ Diamond Polishing System抛光PEEK材料无法满足临床要求的表面粗糙度及光泽度，不推荐用于PEEK材料。虽然Visio.lign Finishing Kit for Composite Veneers抛光系统抛光后，可获得较低表面粗糙度及较高光泽度，但由于其糊状抛光膏颗粒均匀嵌入PEEK材料表面，因此不推荐使用。经CERAMAGE Polishing Kit良好抛光的PEEK材料，其表面粗糙度可接近CAD/CAM树脂基陶瓷，且光泽度更高。

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参考文献

[1] Zol SM, Alauddin MS, Said Z, et al. Description of poly(aryl-ether-ketone) materials (PAEKs), polyetheretherketone (PEEK) and polyetherketoneketone (PEKK) for application as a dental material: a materials science review[J]. Polymers(Basel), 2023, 15(9): 2170-2187. doi: 10.3390/polym15092170.

[2] Alexakou E, Damanaki M, Zoidis P, et al. PEEK high performance polymers: a review of properties and clinical applications in prosthodontics and restorative dentistry[J]. Eur J Prosthodont Restor Dent, 2019, 27(3): 113-121. doi: 10.1922/EJPRD_01892Zoidis09.

[3] Liu Y, Fang M, Zhao R, et al. Clinical applications of polyetheretherketone in removable dental prostheses: accuracy, characteristics, and performance[J]. Polymers (Basel), 2022, 14(21): 4615-4633.doi: 10.3390/polym14214615.

[4] Benli M, Eker Gümüş B, Kahraman Y, et al. Surface roughness and wear behavior of occlusal splint materials made of contemporary and high-performance polymers[J]. Odontology, 2020, 108(2): 240-250. doi: 10.1007/s10266-019-00463-1.

[5] Reyal S, Rajamani V, Gowda E, et al. Comparative prospective clinical evaluation of computer aided design/computer aided manufacturing milled BioHPP PEEK inlays and Zirconia inlays[J]. J Indian Prosthodont Soc, 2021, 21(3): 240-248. doi: 10.4103/jips.jips_57_21.

[6] Elfahl BN, Mostafa TMN. Polyetheretherketone custom CAD-CAM splint for treatment of periodontally affected mobile anterior teeth[J]. J Prosthet Dent, 2022, 127(2): 210-212. doi: 10.1016/j.prosdent.2020.08.031.

[7] Wang S, Li Z, Ye H, et al. Preliminary clinical evaluation of traditional and a new digital PEEK occlusal splints for the management of sleep bruxism[J]. J Oral Rehabil, 2020, 47(12): 1530-1537. doi: 10.1111/joor.13083.

[8] Eda ET, Onur Ş, Ayşegül K, et al. Surface roughness and *Streptococcus mutans* adhesion on surface sealant agent coupled interim crown materials after dynamic loading[J]. BMC Oral Health, 2022, 22(1): 299-309. doi: 10.1186/s12903-022-02323-x.

[9] Bollen CM, Lambrechts P, Quirynen M. Comparison of surface roughness of oral hard materials to the threshold surface roughness for bacterial plaque retention: a review of the literature[J]. Dent Mater, 1997, 13(4): 258-269. doi: 10.1016/s0109-5641(97)80038-3.

[10] Ghazal M, Kern M. The influence of antagonistic surface roughness on the wear of human enamel and nanofilled composite resin artificial teeth[J]. J Prosthet Dent, 2009, 101(5): 342-349. doi: 10.1016/S0022-3913(09)60068-8.

[11] Guo J, Bing Z, Yang J, et al. Effect of roughness and acidic medium on wear behavior of dental resin composite[J]. BMC Oral Health, 2022, 22(1): 470-481. doi: 10.1186/s12903-022-02516-4.

[12] Heimer S, Schmidlin PR, Roos M, et al. Surface properties of polyetheretherketone after different laboratory and chairside polishing protocols[J]. J Prosthet Dent, 2017, 117(3): 419-425. doi: 10.1016/j.prosdent.2016.06.016.

[13] Batak B, Çakmak G, Johnston WM, et al. Surface roughness of high-performance polymers used for fixed implant-supported prostheses[J]. J Prosthet Dent, 2021, 126(2): 254.e1-254.e6. doi: 10.1016/j.prosdent.2020.11.029.

[14] Kurahashi K, Matsuda T, Ishida Y, et al. Effect of polishing protocols on the surface roughness of polyetheretherketone[J]. J Oral Sci, 2020, 62(1): 40-42. doi: 10.2334/josnusd.18-0473.

[15] 王睿瑾, 张嘉琪, 衣颖杰, 等. 牙科可切削聚醚醚酮表面抛光性能的初步研究[J]. 中华口腔医学研究杂志(电子版), 2021, 15(5): 278-283. doi: 10.3877/cma.j.issn.1674-1366.2021.05.004.
Wang RJ, Zhang JQ, Yi YJ, et al. Polishing performance of dental milled polyetheretherketone：an in vitro study[J]. Chin J Stomatol Res(Electron Ed), 2021, 15(5): 278-283. doi: 10.3877/cma.j.issn.1674-1366.2021.05.004.

[16] Sturz CRC, Faber FJ, Scheer M, et al. Effects of various chair-side surface treatment methods on dental restorative materials with respect to contact angles and surface roughness[J]. Dent Mater J, 2015, 34(6): 796-813. doi: 10.4012/dmj.2014-098.

[17] Vulović S, Todorović A, Stančić I, et al. Study on the surface properties of different commercially available CAD/CAM materials for implant-supported restorations[J]. J Esthet Restor Dent, 2022, 34(7): 1132-1141. doi: 10.1111/jerd.12958.

[18] Soliman HAN, Elkholany NR, Hamama HH, et al. Effect of different polishing systems on the surface roughness and gloss of novel nanohybrid resin composites[J]. Eur J Dent, 2021, 15(2): 259-265. doi: 10.1055/s-0040-1718477.

[19] Jin C, Deng J, Pan P, et al. Comparative study on the impact-sliding wear behaviour of CAD/CAM resin-ceramic materials and tooth enamel[J]. Dent Mater, 2023, 39(1): 25-40. doi: 10.1016/j.dental.2022.11.010.

[20] Jefferies SR. Abrasive finishing and polishing in restorative dentistry: a state-of-the-art review[J]. Dent Clin North Am, 2007, 51(2): 379-397. doi: 10.1016/j.cden.2006.12.002.

[21] Jaramillo-Cartagena R, López-Galeano EJ, Latorre-Correa F, et al. Effect of polishing systems on the surface roughness of nano-hybrid and nano-filling composite resins: a systematic review[J]. Dent J (Basel), 2021, 9(8): 95. doi: 10.3390/dj9080095.

[22] Amaya-Pajares SP, Koi K, Watanabe H, et al. Development and maintenance of surface gloss of dental composites after polishing and brushing: review of the literature[J]. J Esthet Restor Dent, 2022, 34(1): 15-41. doi: 10.1111/jerd.12875.

[23] Mörmann WH, Stawarczyk B, Ender A, et al. Wear characteristics of current aesthetic dental restorative CAD/CAM materials: two-body wear, gloss retention, roughness and Martens hardness[J]. J Mech Behav Biomed Mater, 2013, 20: 113-125. doi: 10.1016/j.jmbbm.2013.01.003.

[24] da Costa JB, Ferracane JL, Amaya-Pajares S, et al. Visually acceptable gloss threshold for resin composite and polishing systems [J]. J Am Dent Assoc, 2021, 152(5): 385-392. doi: 10.1016/j.adaj.2020.09.027.

[25] de Melo TP, Delgado A, Martins R, et al. Can specular gloss measurements predict the effectiveness of finishing/polishing protocols in dental polymers? A systematic review and linear mixed-effects prediction model[J]. Oper Dent, 2022, 47(3): e131-e151. doi: 10.2341/21-027-LIT.

[26] Kakaboura A, Fragouli M, Rahiotis C, et al. Evaluation of surface characteristics of dental composites using profilometry, scanning electron, atomic force microscopy and gloss-meter[J]. J Mater Sci: Mater Med, 2007, 18(1): 155-163. doi: 10.1007/s10856-006-0675-8.

（编辑 张琳,邵龙泉）

官网

· 短讯 ·

《口腔疾病防治》被荷兰Embase数据库收录

近期,南方医科大学口腔医院主办的科技期刊《口腔疾病防治》经过严格的评选,被Embase数据库收录,现已正式上线并回溯至2021年文献。

Embase是全球最大、最具权威性的生物医学与药理学文摘数据库,为荷兰《医学文摘》(Excerpta Medica)的在线版本,涵盖1947年以来累计超过4400万条生物医学记录,平均每天有超过8000条记录更新,收录了95个国家/地区入选的8 300多种期刊,据Embase官网收录期刊目录(2023-07-EMBASE-journals)显示,该数据库目前收录中国期刊189种,其中中文期刊109种。

这是继《口腔疾病防治》近年来被美国《乌利希期刊指南》(Ulrichsweb)、荷兰Scopus、瑞典《开放获取期刊指南》(DOAJ)、WHO西太平洋地区医学索引(WPRIM)、日本科学技术振兴机构数据库(JST)、瑞士《健康网络首创研究获取》(HINARI)、波兰《哥白尼索引》(IC)等多个国际重要数据库收录后入选的又一重要国际数据库。

这表明《口腔疾病防治》在主管主办单位的领导下和编委、审稿专家、广大作者、读者及社会各界的大力支持下,《口腔疾病防治》的国际影响力进一步提升,朝着高质量发展,为口腔医学领域广大的临床工作者和科技工作者提供了一个更广阔的国际学术交流平台,助力于双一流的建设和人类口腔健康。

《口腔疾病防治》编辑部