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· 临床研究 ·

内窥镜辅助牙周微创非手术治疗深骨下袋的2年愈合趋势分析

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【摘要】 目的 探讨内窥镜辅助的牙周微创非手术治疗(minimally-invasive non-surgical periodontal therapy, MINST)对深骨下袋的临床治疗效果、影像学变化,并将其与传统刮治和根面平整(scaling and root planning, SRP)的效果对比,为牙周临床治疗提供参考。方法 本研究获医院伦理委员会审批。回顾骨下袋 ≥ 4 mm的牙周病患者资料,分为经内窥镜辅助的MINST组(20例,81个位点)和传统SRP组(20例,80个位点);比较治疗前(T0)、治疗后12个月(T1)、治疗后24个月(T2)的探诊深度(probing depth, PD)、临床附着丧失(clinical attachment loss, CAL)的临床指标,并分析影像学骨下袋缺损高度、角度的变化;初次治疗后12个月内每3个月进行随访和维护治疗,治疗后12至24个月内每6个月进行随访和维护治疗。结果 MINST组病人组内比较:PD、CAL随治疗后时间持续减小($P < 0.001$),且影像学检查显示骨下袋缺损高度减小($P < 0.001$),骨下袋变浅;骨缺损角度随治疗后时间增大($P < 0.001$),前12个月的高度减小和角度增大变化大于后12个月($P < 0.001$)。SRP组病人组内比较结果与MINST组相同。治疗后12个月和24个月,MINST组PD和CAL均小于SRP组($P < 0.001$);MINST组缺损高度恢复量大于SRP组($P < 0.001$),MINST组缺损角度增加大于SRP组($P < 0.001$)。结论 牙周微创非手术治疗能明显促进深骨下袋愈合及牙槽骨的再生,影像学反映的牙槽骨愈合具有先快后慢的特点,内窥镜辅助的MINST相对于传统SRP可以获得更好的骨下袋临床指标和影像学变化。

【关键词】 骨下袋; 牙周内窥镜; 牙周微创非手术治疗; 牙周炎; 牙周基础治疗; 曲面体层片; 影像学; 龈下刮治和根面平整术

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Two-year follow-up of the outcomes of endoscope-assisted minimally invasive nonsurgical periodontal therapy for deep intrabony defects YANG Zhiyu¹, WANG Jinmeng¹, LEI Lang², LI Houxuan¹. 1. Department of Periodontics, Nanjing Stomatological Hospital & Medical School of Nanjing University, Nanjing 210008, China; 2. Department of Orthodontics, Nanjing Stomatological Hospital & Medical School of Nanjing University, Nanjing 210008, China

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【Abstract】 Objective To explore the clinical efficacy and imaging changes of minimally invasive nonsurgical periodontal therapy (MINST) assisted by endoscopy for deep intrabony defects and to compare its effectiveness with that of traditional scaling and root planning (SRP) to therefore provide a reference for clinical periodontal treatment. **Methods**

Patients with deep intrabony defects ≥ 4 mm in size were selected and divided into two groups: the MINST (MINST, 20 cases, 81 sites) group and the classic scaling and root planing (SRP, 20 cases, 80 sites) group. Before treatment and 12 and 24 months after treatment, probing depth (PD) and clinical attachment loss (CAL) were examined. Moreover, changes in the depth and angle of the intrabony defects were analyzed. Follow-up examination and maintenance treat-

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ment should be conducted every 3 months for 12 months after the initial treatment and every 6 months thereafter until 24 months. **Results** The PD and CAL of patients in both groups continued to decrease ($P < 0.001$), and imaging examinations revealed a decrease in defect depth and an increase in intrabony defect angle ($P < 0.001$). The changes in the first 12 months were significantly greater than those in the last 12 months in both groups ($P < 0.001$). The decreases in PD, CAL, and depth of intrabony defects and increase in angle in the MINST group were significantly greater than those in the SRP group ($P < 0.001$). At 12 and 24 months after treatment, the PD and CAL in the MINST group were lower than those in the SRP group ($P < 0.001$). The defect height of the MINST group decreased more than that of the SRP group ($P < 0.001$), and the defect angle of the MINST group increased more than that of the SRP group ($P < 0.001$). **Conclusion** Minimally invasive nonsurgical periodontal therapy can significantly promote the healing of deep intrabony defects and the regeneration of alveolar bone. Imaging reflects that alveolar bone healing is rapid at first and then slows. Compared with traditional SRP, endoscopically assisted MINST can yield better clinical indicators and imaging changes in intrabony defects.

【Key words】 intrabony defects; periodontal endoscope; minimally-invasive non-surgical periodontal therapy; periodontitis; periodontal initial therapy; orthopantomography; radiography; scaling and root planing

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牙周炎是发生于牙齿支持组织的炎症感染性疾病,持续的牙周组织炎症可能导致垂直型骨吸收,临床表现为骨下袋^[1]。深度 ≥ 4 mm骨下袋的患牙经过牙周基础治疗控制炎症后,通过再生手术可获得临床和影像学的改善^[2-3]。但是,由于对手术创伤、术后并发症、骨移植物和胶原膜费用的担心,部分患者不愿意进行牙周再生手术^[4-5]。对于深骨下袋,传统治疗以再生手术为主,非手术治疗仅作为前期的治疗基础。近年来,除了牙周再生术外,牙周微创非手术治疗(minimally-invasive non-surgical periodontal therapy, MINST)也被用于重度牙周炎的治疗,通过治疗器械的改良来实现最大程度的清创和最小创伤,但对于这些患牙骨下袋具体形态和愈合变化的探究鲜见报道^[6-8]。在牙周再生手术过程中,医生可在直视下彻底清除牙结石,并植入骨粉、釉基质衍生物、骨形成蛋白等促进骨再生的材料,以获得牙周再生;在MINST中,放大镜或者内窥镜辅助,有助于根面彻底清创,同时形成稳定的血凝块有助局部牙周组织再生^[9]。

牙周内窥镜已较长时间应用于牙周非手术治疗,它可以提高视野的可视性,放大牙周袋内的术区,从而提高牙周非手术治疗的效果^[10-11]。已有报道证明,在减小探诊深度(probing depth, PD)和临床附着丧失(clinical attachment loss, CAL)方面,经内窥镜辅助的刮治效果要优于传统的刮治和根面

平整术(scaling and root planing, SRP)^[12]。MINST是常规牙周内窥镜辅助的牙周非手术治疗的改良,强调治疗器械的精细、治疗过程的微创性^[13]。

微创治疗的临床效果是临床医生关注的焦点^[14]。牙周内窥镜辅助的MINST是否有助于骨下袋的牙周组织炎症控制和软硬组织的愈合,其临床研究国内较少报道。本研究分析内窥镜辅助的MINST对深骨下袋的临床治疗效果、影像学变化,为牙周临床治疗提供参考。

1 资料和方法

本研究经南京大学医学院附属口腔医院伦理委员会审查批准(NJSH-2023NL-061),病例资料已作去个人识别信息处理,符合个人信息保护要求。

1.1 病例资料

本研究为回顾性队列研究,收集2015年8月至2020年8月在南京市口腔医院牙周病科就诊的40例病人,共计161个骨内缺损位点。根据患者接受内窥镜辅助的MINST或者传统SRP,分别纳入MINST组(20例,80个位点)和SRP组(20例,81个位点)。

纳入标准:①年龄 > 18 岁;②初诊时记录为基线资料(T0),临床探诊PD > 5 mm, X线片上可观测到 ≥ 4 mm深度的骨下袋角型缺损;③经过非手术治疗之后12个月(T1)、24个月(T2)均有完整的

复诊影像资料和临床检查记录资料;④在此治疗前未接受过牙周相关治疗;⑤患者能做到定期维护、具有良好的依从性。

排除标准:①有全身系统性疾病(如高血压、心脏病、糖尿病、肾病等),处于妊娠期或哺乳期,或长期服用影响全身状况和牙周状况药物者;②选取的位点在治疗后24个月内接受了其他治疗包括牙周手术治疗等;③吸烟史;④牙周牙髓联合病变的患牙;⑤存在咬合创伤、牙齿错位畸形等可能促进牙周组织损伤的因素。

本研究纳入的所有患者,在进行传统的SRP或内窥镜辅助的MINST之前,均进行充分的口腔卫生指导,患者学习正确的刷牙方法,学习使用牙线、牙间隙刷等口腔卫生措施;所有患者均接受充分的龈上洁治术,彻底去除龈上结石和菌斑,减轻炎症。

样本量计算:采用Cohen经典的统计学计算模型,结合Nibali等^[8]研究,预设存在中等效应量为0.25,统计检验力 $1-\beta=0.8$,显著水平 $\alpha=0.05$,得样本量为53;又根据同等效应量情况下3组间和2组内最高要求,各组样本量为78,最终53和78取较高者,本研究各组样本量最低要求为78例。

1.2 治疗方法

MINST组:鉴于MINST治疗过程中缺乏统一的治疗方式,本研究选取的患者采用下面的方式进行治疗:①局麻下进行彻底的牙周清创,至牙周袋底;②采用牙周内窥镜(perioscopy[®],美国),辅助牙周治疗,以获得良好的视野;③使用具有负反馈调节功能的压电式超声治疗设备(EMS700,瑞士),以及细长的超声工作尖,根据牙石的形态和质地调整功率,以彻底清除根面牙石,并避免对根面的过度刮治,造成健康牙骨质丧失;④避免牙龈的直接创伤,特别是龈乳头尖端的刺激;⑤刮治结束后,让血液充盈骨下袋缺损,形成稳定的血凝块,

避免龈下冲洗,或冲洗后再次轻柔触及牙周袋内壁让血液充盈。治疗并未使用牙周敷料。

SRP组:在局麻下,采用与MINST治疗同样型号的压电式超声设备和工作尖,术中尽可能去除根面牙石,必要时进行手工器械辅助根面平整,术中注意减少对牙龈的搔刮和过度刺激。

所有患者在治疗后24个月内均接受了口腔健康宣教和口腔卫生指导,患者能做到定期维护、具有良好的依从性。治疗后3个月,患者回访进行疗效评估,对患者再次进行充分的口腔卫生指导,根据口腔卫生状况进行必要的龈上洁治和龈下刮治。初次治疗后12个月内,每3个月进行随访和维护治疗;12至24个月,每6个月进行随访和维护治疗。

1.3 牙周临床检查

MINST组和SRP组患者,在治疗前、治疗后12个月和24个月回访时都有牙周临床指标检查资料。临床检查采用Florida电子探针(Florida company, 美国)探测,记录颊侧近中、颊侧正中、颊侧远中、舌侧远中、舌侧正中和舌侧近中6个位点的PD;检查记录龈缘到牙周袋底的距离和龈缘到釉牙骨质界的距离,计算临床CAL。

1.4 影像学资料与测量

所有患者在治疗前、治疗后12个月和24个月时的曲面体层片资料均由同一检查者进行定点分析。定点标志如下:①A点:骨下袋牙位的釉牙骨质界;②B点:牙槽嵴顶点,即牙槽骨最冠方的位置;③C点:骨缺损的底点,即牙周膜间隙具有正常影像的最高点;④牙长轴:纵行通过牙体中心和牙体长轴的假想轴线。将A、B、C三点向牙长轴做垂线,形成垂足A'、B'、C',计算下列骨缺损的相关指标:①垂直缺损高度:B'到C'的距离;②骨缺损角度:A、B和C点之间构成的 $\angle ACB$ 的大小(图1)。

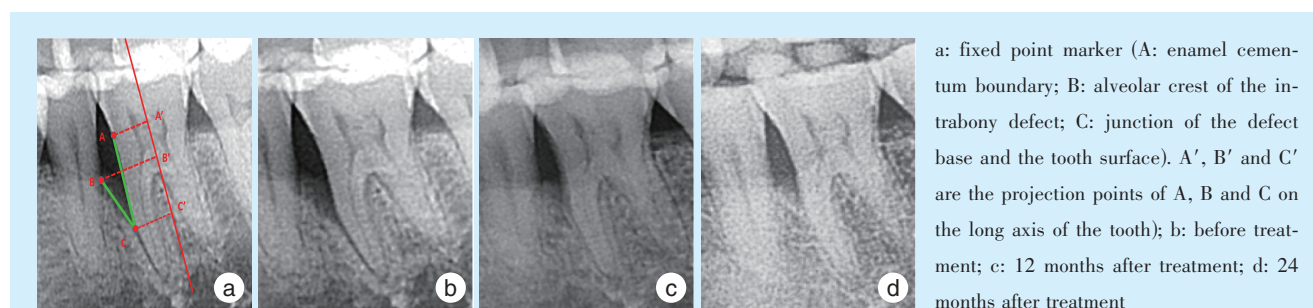


Figure 1 Image diagram of the intrabony defect marks

图1 骨下袋标志点示意图

1.5 统计学分析

应用 SPSS 21.0 软件对数据进行统计学分析。数据以均数 ± 标准差表示。采用一般线性模型重复测量方差分析 3 个时期同组同名统计量是否存在差异, Mauchly 的球形度检验同组同名统计量是否随时间变化, Dunnett 法单独分析 3 个时期两两比较是否存在差异。采用一般线性模型附带配对检验比较同种治疗效果下术前术后两时间段指标测量值变化差异。组间比较采用独立样本 *t* 检验。 $P < 0.05$ 为差异有统计学意义。

2 结果

2.1 基本资料

40 例具有骨下袋缺损的患者中, 共 161 个位点纳入研究(表 1), 其中 SRP 组的年龄为 (39.05 ± 7.81) 岁, MINST 组的年龄为 (36.50 ± 5.54) 岁, 差异无统计学意义 ($P = 0.150$); 两组患者在性别 ($P = 0.342$)、牙位分布 ($P = 0.167$) 差异均无统计学意义。

2.2 MINST 组和 SRP 组临床与影像指标统计分析结果

2.2.1 MINST 组和 SRP 组临床与影像指标结果及重复测量方差齐性检验 重复测量方差齐性检验显示: SRP 组的 PD、CAL、缺损高度、缺损角度在 T0、T1、T2 三组间方差无显著差异 ($P > 0.05$), MINST 组的 PD、CAL、缺损高度、缺损角度在 T0、T1、T2 三组间方差无显著差异 ($P > 0.05$)。Mauchly 的球形度检验结果: MINST 组和 SRP 组 PD、CAL、缺损高度、缺损角度球状检验结果均为 $P < 0.001$, 不符合球状检验。因此, 主效应检验选择 Green-

表 1 骨下袋缺损患者的基本资料

Table 1 Basic information of the patients with intrabony defects

Groups	SRP	MINST	t/χ^2	<i>P</i>
Number of patients	20	20	-	-
Number of sites	81	80	-	-
Male/Female	11/9	8/12	0.902	0.342
Age/years	39.05 ± 7.81	36.50 ± 5.54	1.021	0.150
Front teeth	29	18		
Premolar teeth	15	16	3.577	0.167
Molar teeth	37	46		

SRP: scaling and root planning; MINST: minimally-invasive non-surgical periodontal therapy

house-Geisser 检验: 对于 T0、T1、T2 时间节点的指标: SRP 组 PD、CAL、缺损高度在 T0、T1、T2 三组随时间减少, 缺损角度随时间增加 ($P < 0.001$); MINST 组 PD、CAL、缺损高度在 T0、T1、T2 三组随时间减少, 缺损角度随时间增加 ($P < 0.001$) (表 2)。

2.2.2 MINST 组和 SRP 组临床与影像指标组内变化趋势分析 在 T0 时间点, SRP 组和 MINST 组均存在深牙周袋和明显的附着丧失。在 T1 时间点, SRP 组和 MINST 组的 PD 均较各自的 T0 减少 ($P < 0.001$)。在 T2 时间点, MINST 组的 CAL 和 PD 指标均较 T1 时间点明显改善 ($P < 0.001$), SRP 组的 PD ($P = 0.238$) 和 CAL ($P = 0.683$) 则无明显变化 (表 3、表 4)。

在 T0 时间点, MINST 组和 SRP 组均有明显的垂直型牙槽骨吸收。在 T1 时间点, MINST 组和 SRP 组的缺损高度与 T0 时间点相比, 均减少 ($P < 0.001$), MINST 组和 SRP 组的缺损角度比 T0 增大

表 2 MINST 组和 SRP 组临床与影像指标统计结果及重复测量方差齐性检验

Table 2 Statistical results of clinical and imaging indicators in the MINST group and SRP group and the homogeneity test of repeated measures variance $n = 20, \bar{x} \pm s$

Index	Groups	T0	T1	T2	<i>P</i> values of Mauchly ball	<i>P</i> values of Greenhouse-Geisser
PD/mm	MINST	5.752 ± 2.322	3.102 ± 1.703	2.762 ± 1.493	< 0.001	< 0.001
	SRP	5.783 ± 1.563	3.952 ± 1.603	3.523 ± 1.522	< 0.001	< 0.001
CAL/mm	MINST	7.202 ± 2.421	4.462 ± 2.444	3.963 ± 2.192	< 0.001	< 0.001
	SRP	7.513 ± 2.262	5.573 ± 2.523	5.282 ± 2.593	< 0.001	< 0.001
Defect height/mm	MINST	6.293 ± 1.192	3.843 ± 1.172	3.542 ± 1.113	< 0.001	< 0.001
	SRP	5.552 ± 1.373	4.092 ± 1.202	3.992 ± 1.163	< 0.001	< 0.001
Defect angle/°	MINST	40.913 ± 12.812	60.153 ± 11.973	65.282 ± 11.403	< 0.001	< 0.001
	SRP	47.033 ± 15.213	60.121 ± 12.423	65.032 ± 12.153	< 0.001	< 0.001

PD: probing depth; CAL: clinical attachment loss; MINST: minimally-invasive non-surgical periodontal therapy; SRP: scaling and root planning; T0: before treatment; T1: 12 months after treatment; T2: 24 months after treatment

($P < 0.001$)。在T2时间点,与T1相比,MINST组的缺损高度进一步减少,角度进一步增大($P < 0.001$),SRP组则无明显变化(表3、表4)。

进一步对比分析了治疗过程中的骨下袋形态的变化趋势,从治疗开始到治疗后12个月(T0 ~ T1),SRP组缺损高度恢复量小于治疗开始到治疗后24个月(T0 ~ T2)($P < 0.001$),SRP组缺损角度增加值小于治疗开始到治疗后24个月(T0 ~ T2)($P < 0.001$);从治疗后12个月到24个月(T1 ~ T2),SRP组缺损高度恢复量小于从治疗开始到治疗后12个月(T0 ~ T1)($P < 0.001$),SRP组缺损角度增加值小于治疗开始到治疗后24个月(T0 ~ T2)($P < 0.001$)(表3)。从治疗开始到治疗后12个月(T0 ~ T1),MINST组缺损高度恢复量小于治疗开始到治疗后24个月(T0 ~ T2)($P < 0.001$),MINST组缺损角度增加值小于治疗开始到治疗后24个月(T0 ~ T2)($P < 0.001$);从治疗后12个月到治疗后24个月(T1 ~ T2),MINST组缺损高度恢复量小于从治疗开始到治疗后12个月(T0 ~ T1)($P < 0.001$),MINST组缺损角度增加值小于治疗开始到治疗后24个月(T0 ~ T2)($P < 0.001$)(表4)。这提

示MINST组和SRP组的缺损高度减小和缺损角度增大是一个持续的过程,但前12个月的变化要显著大于后12个月。

2.2.3 MINST组和SRP组临床与影像指标及变化趋势组间对照 在T0时间点,MINST组和SRP组均存在深牙周袋和明显的附着丧失,两组之间PD和CAL差异均无统计学意义($P > 0.05$)。在T1时间点,MINST组PD和CAL小于SRP组($P < 0.001$)。在T2时间点,MINST组的CAL和PD指标均小于SRP组($P < 0.001$)(表5)。

在T0时间点,MINST组和SRP组均有明显的垂直型牙槽骨吸收,MINST组的缺损高度大于SRP组($P < 0.001$),MINST组缺损角度小于SRP组($P < 0.001$),提示MINST组呈窄而深的牙槽骨吸收。在T1时间点,MINST组和SRP组之间缺损高度和缺损角度差异无统计学意义($P > 0.05$)。在T2时间点,MINST组的缺损高度小于SRP组($P = 0.013$),MINST组缺损角度与SRP组差异无统计学意义($P = 0.895$)(表5)。

从治疗开始到治疗后12个月(T0 ~ T1),MINST组缺损高度恢复量大于SRP组($P < 0.001$),MINST

表3 SRP组临床与影像指标组内变化分析

Table 3 Variation analysis of clinical and imaging indices in the SRP group n = 20

Index	Group pairwise	$\bar{x} \pm s$	t	P	95%CI	
					Lower	Upper
PD/mm	T0-T1	1.827 ± 0.244	-0.313	< 0.001	1.346	2.299
	T0-T2	2.259 ± 0.244	-0.485	< 0.001	1.790	2.753
	T1-T2	0.432 ± 0.247	-0.003	0.238	-0.071	0.891
CAL/mm	T0-T1	1.938 ± 0.366	-0.457	< 0.001	1.231	2.679
	T0-T2	2.222 ± 0.388	-0.583	< 0.001	1.485	3.018
	T1-T2	0.284 ± 0.390	0.004	0.683	-0.462	1.038
Defect height/mm	T0-T1	1.463 ± 0.201	0.486	< 0.001	1.090	1.840
	T0-T2	1.562 ± 0.201	0.004	< 0.001	1.140	1.955
	T1-T2	0.099 ± 0.185	-0.002	0.437	-0.296	0.467
Defect angle/°	T0-T1	-13.080 ± 2.184	0.539	< 0.001	-17.427	-8.868
	T0-T2	-17.995 ± 2.168	-0.681	< 0.001	-22.356	-13.922
	T1-T2	-4.915 ± 1.882	-0.111	0.059	-8.655	-1.293
Defect height variation/mm	T0T1-T0T2	-4.912 ± 3.617	-12.231	< 0.001	-5.715	-4.116
	T0T1-T1T2	8.164 ± 6.664	11.026	< 0.001	6.691	9.638
Defect angle variation/°	T0T1-T0T2	-0.099 ± 0.243	-3.673	< 0.001	-0.153	-0.045
	T0T1-T1T2	1.364 ± 0.602	20.374	< 0.001	1.231	1.497

PD: probing depth; CAL: clinical attachment loss; SRP: scaling and root planning; T0: before treatment; T1: 12 months after treatment; T2: 24 months after treatment; T0T1: before treatment to 12 months after treatment; T0T2: before treatment to 24 months after treatment; T1T2: 12 months after treatment to 24 months after treatment

表4 MINST组临床与影像指标组内变化分析

Table 4 Variation analysis of clinical and imaging indexes in MINST group n = 20

Index	Group pairwise	$\bar{x} \pm s$	t	P	95%CI	
					Lower	Upper
PD/mm	T0-T1	2.650±0.296	14.314	< 0.001	1.936	3.364
	T0-T2	2.988 ± 0.297	15.856	< 0.001	2.274	3.701
	T1-T2	0.338 ± 0.276	3.844	< 0.001	-0.376	1.051
CAL/mm	T0-T1	0.088 ± 0.211	9.854	< 0.001	-0.418	0.593
	T0-T2	0.250 ± 0.209	9.562	< 0.001	-0.256	0.756
	T1-T2	0.162 ± 0.210	1.915	0.059	-0.343	0.668
Defect height/mm	T0-T1	2.444 ± 0.183	24.791	< 0.001	2.002	2.886
	T0-T2	2.751 ± 0.176	24.871	< 0.001	2.310	3.193
	T1-T2	0.307 ± 0.163	3.673	< 0.001	-0.135	0.749
Defect angle/°	T0-T1	-19.244 ± 1.909	-16.836	< 0.001	-23.846	-14.641
	T0-T2	-24.374 ± 1.918	-18.161	< 0.001	-28.976	-19.772
	T1-T2	-5.130 ± 1.908	-12.231	< 0.001	-9.733	-0.528
Defect height variation/mm	T0T1-T0T2	-5.130 ± 3.511	-13.070	< 0.001	-5.912	-4.349
	T0T1-T1T2	14.113 ± 8.555	14.755	< 0.001	12.210	16.017
Defect height variation/°	T0T1-T0T2	-0.307 ± 0.249	-11.030	< 0.001	-0.363	-0.252
	T0T1-T1T2	2.137 ± 0.722	26.458	< 0.001	1.976	2.298

PD: probing depth; CAL: clinical attachment loss; MINST: minimally-invasive non-surgical periodontal therapy; T0: before treatment; T1: 12 months after treatment; T2: 24 months after treatment; T0T1: before treatment to 12 months after treatment; T0T2: before treatment to 24 months after treatment; T1T2: 12 months after treatment to 24 months after treatment

表5 MINST组和SRP组临床与影像指标及变化趋势组间对照

Table 5 Comparison of the clinical and imaging indices and variation trends between the MINST group and SRP group n = 20

Index	Groups	$\bar{x} \pm s(\text{MINST-SRP})$	t	P	95%CI	
					Lower	Upper
PD/mm	T0	0.028 ± 0.311	0.089	0.929	-0.586	0.642
	T1	-0.851 ± 0.261	-3.263	< 0.001	-1.366	-0.336
	T2	-0.756 ± 0.237	-3.184	< 0.001	-1.225	-0.287
CAL/mm	T0	0.306 ± 0.369	0.829	0.408	-0.423	1.036
	T1	-1.105 ± 0.391	-2.828	< 0.001	-1.877	-0.333
	T2	-1.321 ± 0.378	-3.494	< 0.001	-2.068	-0.575
Defect height/mm	T0	0.736 ± 0.203	3.622	< 0.001	0.335	1.137
	T1	-0.245 ± 0.187	-1.312	0.191	-0.615	0.124
	T2	-0.453 ± 0.179	-2.526	0.013	-0.808	-0.099
Defect angle/°	T0	-6.132 ± 2.218	-2.765	0.006	-10.512	-1.752
	T1	0.031 ± 1.923	0.016	0.987	-3.767	3.830
	T2	0.247 ± 1.857	0.133	0.895	-3.421	3.914
Defect height variation/mm	T0T1	0.981 ± 0.097	10.148	< 0.001	0.790	1.172
	T0T2	1.189 ± 0.104	11.482	< 0.001	0.985	1.394
	T1T2	0.208 ± 0.039	5.358	< 0.001	0.131	0.284
Defect height variation/°	T0T1	6.164 ± 1.177	5.239	< 0.001	3.840	8.488
	T0T2	6.379 ± 1.393	4.578	< 0.001	3.627	9.131
	T1T2	0.215 ± 0.562	0.383	0.702	-0.895	1.325

PD: probing depth; CAL: clinical attachment loss; MINST: minimally-invasive non-surgical periodontal therapy; SRP: scaling and root planning; T0: before treatment; T1: 12 months after treatment; T2: 24 months after treatment; T0T1: before treatment to 12 months after treatment; T0T2: before treatment to 24 months after treatment; T1T2: 12 months after treatment to 24 months after treatment

组缺损角度增加大于SRP组($P < 0.001$);从治疗后12个月到24个月(T1 ~ T2),MINST组缺损高度恢复量大于SRP组($P < 0.001$),两组间缺损角度的变化差异无统计学意义($P = 0.702$)。在整个治疗过程中,MINST组影像学改变趋势整体呈现出较SRP组更显著的表现。

3 讨论

在操作微创的同时获得最佳的治疗效果一直是牙周治疗的方向^[14]。在深骨下袋的治疗中,牙周再生治疗手术可以创造牙周愈合的良好环境,促进骨充填、CAL减少、牙周袋探诊深度(pocket probing depth, PPD)变浅^[15]。牙周再生治疗的手术方式经历了开放式的翻瓣手术、引导组织再生术、减少翻瓣范围和保留龈乳头的微创牙周手术、各种结合生物材料和生物因子的改良MIST,这些手术均显示出牙周组织不同程度的再生^[16-17]。

除上述翻瓣手术外,有研究者提出了MINST治疗深骨下袋,MINST组CAL增加2.6 mm,翻瓣手术组增加2.8 mm,组间无差异;两组之间牙龈退缩程度也无差别^[18]。有研究表明,MINST可使牙周袋变浅3.12 mm和CAL减少2.78 mm^[19]。一项随机对照研究显示,在治疗24个月后,MINST结合釉基质衍生物(enamel matrix derivatives, EMD)可获得PPD减少(3.6 ± 1.0) mm, CAL增加(3.2 ± 1.1) mm;牙周微创手术治疗(minimally-invasive surgical periodontal therapy, MIST)结合EMD可以使PPD减少(3.7 ± 0.6) mm, CAL增加(3.6 ± 0.9) mm^[20]。本研究显示,在治疗后24个月时,MINST可让CAL平均增加2.99 mm, PPD平均减少3.24 mm,获得了与文献中相似的临床效果,提示MINST可在临床中应用于骨下袋的治疗。同时,治疗后12个月、24个月时MINST组的牙周指标进一步改善,提示MINST技术可获得长期稳定的临床效果。本研究目前探讨了MINST与传统SRP的差异,然而由于纳入条件的差异过大以及治疗周期和方式存在较大分歧,很难构建MINST与翻瓣手术间的合理对比,这是下一步研究需要思考和拓展的问题。

深骨下袋的治疗效果受多种治疗因素的影响,如年龄、牙位、骨下袋的三维形态、骨壁的数量、宽度、深度等^[6, 21-22]。本研究中重点关注了骨下袋缺损的深度和角度的影响。Nibali等^[8]使用3.4倍放大镜辅助的MINST技术治疗骨下袋,结果显示骨内垂直缺损的平均深度减少了2.93 mm,而

平均缺损角度从基线时的 28.5° 变为 44.35° 。本研究结果同样显示在治疗后的24个月时,缺损深度平均减少了2.75 mm,缺损角度减少了 24.37° 。系统回顾显示,骨下袋的形态特别是骨壁数量和角度是影响术后骨充填、CAL增加和PPD减少的重要因素^[23]。需要注意的是,尽管本研究显示MINST组CAL减少、PPD减少等临床指标优于SRP组,但本研究中MINST组的骨下袋的缺损角度小于SRP组,这可能影响牙周治疗效果的评价。

牙周治疗的理念在近半个世纪以来处于改变之中,从早期的感染牙本质、牙骨质的彻底去除、切除性的牙周手术去除感染的骨组织和软组织,到现在以去除牙结石,从而去除菌斑生物膜,保留牙骨质以获得牙周组织再生^[24-25]。相较于传统刮治,内窥镜辅助使得龈下牙石和菌斑的清除变得可视化,从而实现了更为高效和彻底的清创,更好地去除了牙周的刺激因素^[26-27]。徐玉娟等^[12]对内窥镜辅助龈下超声刮治与传统超声刮治治疗残存牙周袋的研究显示,在治疗后6周和3个月后,两种方式均可对于患牙的PD、CAL产生明显的改善效果;6周时两种治疗的疗效无明显差异,而在3个月时,试验组在PD减少方面相对于传统刮治更有优势。

MINST技术的核心在于通过精细的治疗获得牙周组织修复的环境:通过不含肾上腺素的麻醉、避免切开缝合、减少龈乳头损伤等操作避免牙龈创伤;稳定的血凝块有助于提供牙周干细胞修复的微环境,从而促进骨沉积和矿化,从而避免长上皮结合对牙周修复的影响;精细的超声工作尖和内窥镜或放大镜辅助的清创,以彻底清除牙石,保护牙骨质,减少患者不适^[28]。MINST的应用范围逐渐扩大,有研究者将MINST用于水平型骨吸收的Ⅲ期牙周炎,也显示其具有良好的临床治疗效果^[7]。

牙周治疗的技术是一个逐步进展的过程,从早期的人工器械到后来的超声器械,从强调病变牙骨质的彻底去除到减少牙骨质去除,治疗理念一直趋向于微创化、舒适化^[23]。MINST是内窥镜辅助的牙周非手术治疗的改良,其区别在于超声和手工治疗器械的精细化、超声功率的最小化,以突出微创,减少牙周组织的损伤^[29-30]。

本研究为回顾性研究,纳入样本的偏倚难以避免。年龄、牙位、骨袋的深度、角度以及骨壁数是与深骨下袋的临床治疗效果密切相关^[31-32]。虽

然本文两组之间的年龄、牙位无统计学差异,但同一患者中纳入了多个位点,在进一步的研究中需要减少这种来自于同一患者不同位点间的关联性。此外,需要进一步提高影像学资料的一致性,以提高数据的可比性。

尽管本实验证实 MINST 用于治疗深骨下袋取得了与传统 SRP 治疗的临床效果,需要注意的是,下面一些问题仍需要进一步探讨。MINST 与手术入路的 MIST 临床操作时间不同,二者的临床成本也是需要密切关注的问题;MINST 技术如何结合生物材料和生物分子,如 EMD 和骨胶原成分,从而成为结合再生技术的 MINST,这种改良后的 MINST 能否取得更好的临床效果,也是需要进一步探讨的问题^[33-34]。MINST 技术对于医生的技术熟练程度要求高,治疗时间也是影响患者体验的重要因素。

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