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·临床研究·

口腔显微镜辅助微翻瓣牙周植骨术治疗下颌磨牙Ⅱ度根分叉病变

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【摘要】 目的　探讨口腔显微镜辅助微翻瓣牙周植骨术治疗下颌磨牙Ⅱ度根分叉病变的临床疗效，为其在根分叉病变的治疗提供临床依据。**方法**　本研究已通过单位伦理委员会审查批准，并获得患者知情同意。纳入60颗因牙周炎导致Ⅱ度根分叉病变的下颌磨牙，采用随机数字表进行临床对照研究，根据术式不同分为对照组(n=30)和试验组(n=30)。对照组采用内斜切口及垂直切口翻瓣，裸眼行牙周翻瓣植骨手术；试验组则在口腔显微镜辅助下，行无垂直切口的微翻瓣牙周植骨手术。比较两组术前及术后6个月的探诊深度(probing depth，PD)、出血指数(bleeding index，BI)、牙龈退缩(gingival recession，GR)；测量两组术后6个月的垂直骨高度增加量(vertical bond height increment，VBHI)；评估两组患者术后4、24、48 h的疼痛程度；随访记录术后6个月并发症情况。**结果**　两组在术后6个月时的PD、BI较术前均有改善：对照组术前PD为(7.33±1.72)mm，术后6个月PD为(3.37±0.96)mm，差异具有统计学意义(P<0.001)；试验组术前PD为(7.27±1.57)mm，术后6个月PD为(3.00±0.69)mm，差异具有统计学意义(P<0.001)；对照组BI由术前3.03±1.03降低到术后6个月的0.77±0.82(P<0.001)，试验组BI由术前3.20±1.09降至术后6个月的0.73±0.64(P<0.001)，差异均具有统计学意义。试验组在术后6个月，GR[(0.70±0.59)mm]较术前[(1.26±0.94)mm]显著改善(P=0.007)，对照组术后6个月的GR[(1.37±0.89)mm]较术前[(1.13±0.97)mm]增加，但差异无统计学意义(P=0.337)。组间对比结果显示，两组术后6个月的PD、BI比较差异无统计学意义(PD：P=0.096，BI：P=0.861)；试验组GR低于对照组，差异有统计学意义(P=0.001)。两组术后VBHI比较差异无统计学意义(P=0.128)。术后4、24 h试验组疼痛程度评分均低于对照组(P<0.001)。所有患者均未出现并发症。**结论**　口腔显微镜辅助下微翻瓣牙周植骨术治疗下颌磨牙Ⅱ度根分叉病变可有效改善患者牙周状况，植骨效果良好，患者疼痛感较轻，具有良好的安全性。

【关键词】 牙周炎；　根分叉病变；　微创翻瓣；　植骨术；　口腔显微镜；　牙龈退缩；　探诊深度；　出血指数；　垂直骨高度增加量
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Microscope-assisted minimally invasive flap periodontal bone grafting for mandibular molar grade Ⅱ furcation defects

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【Abstract】 Objective　To investigate the clinical efficacy of oral microscope-assisted microflap periodontal bone grafting in treating class Ⅱ furcation involvement in mandibular molars, and to provide clinical evidence for its treatment in furcation involvement. **Methods**　This study was reviewed and approved by the institutional ethics committee,

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and informed consent was obtained from all patients. Sixty mandibular molars with class II furcation involvement caused by periodontitis were enrolled in a randomized controlled clinical study, utilizing a random number table method. Patients were categorized into a control group (n=30) and an experimental group (n=30) based on the surgical procedure employed. The control group underwent periodontal flap surgery with an internal oblique incision and vertical incision; this procedure was performed without the aid of a microscope. Conversely, the experimental group underwent micro flap periodontal bone grafting surgery without vertical incision; an oral microscope was used for this procedure. Both groups were analyzed 6 months after surgery, and postoperative gingival recession (GR), probing depth (PD), bleeding index (BI), vertical bone height increase (VBHI), pain level, and complications were recorded. **Results** Both groups showed improvement in PD and BI after 6 months compared to preoperative levels: the control group had a preoperative PD of (7.33 ± 1.72 mm) and a 6-month postoperative PD of (3.37 ± 0.96 mm), with statistically significant differences (P<0.001). The preoperative PD of the experimental group was (7.27 ± 1.57 mm), and the 6-month postoperative PD was (3.00 ± 0.69 mm), with statistically significant differences (P<0.001). The BI of the control group decreased from 3.03 ± 1.03 before surgery to 0.77 ± 0.82 at 6 months after surgery (P<0.001), while the BI of the experimental group decreased from 3.20 ± 1.09 before surgery to 0.73 ± 0.64 at 6 months after surgery (P<0.001), and the differences were statistically significant. The experimental group showed a significant improvement in GR (0.70 ± 0.59 mm) compared to preoperative GR (1.26 ± 0.94 mm) at 6 months after surgery (P=0.007), while the control group showed an increase in GR (1.37 ± 0.89 mm) at 6 months after surgery compared to preoperative GR (1.13 ± 0.97 mm), but the difference was not statistically significant (P=0.337). The inter group comparison results showed that there were no statistically significant differences in PD and BI between the two groups at 6 months after surgery (PD: P=0.096, BI: P=0.861); The GR of the experimental group was lower than that of the control group, and the difference was statistically significant (P=0.001). There was no statistically significant difference in postoperative VBHI between the two groups (P=0.128). The pain level scores of the experimental group were lower than those of the control group at 4 and 24 hours after surgery (P<0.001). None of the patients experienced complications. **Conclusion** Microflap periodontal bone grafting assisted by an oral microscope effectively improves the periodontal condition of patients with grade Ⅱ root bifurcation lesions of mandibular molars, and the bone grafting effect is good, with mild pain and good safety.

【Key words】 periodontitis; furcation defects; minimally invasive flap; bone graft; oral microscope; gingival recession; probing depth; bleeding index; vertical bond height increment

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牙周炎是成人牙齿早期丧失的首要原因[1-2]，牙槽骨吸收是牙周炎晚期的重要病理变化。牙槽骨吸收的形式通常包括水平型、垂直型及凹坑状骨吸收。牙周再生性手术(periodontal regenerative surgery，PRS)能改善牙槽骨缺损，促使骨再生及附着形成，目前常用的术式包括牙周植骨术(bone graft procedures，BGP)、引导性组织再生术(guided tissue regeneration，GTR)等[3-4]。研究表明，BGP和GTR在临床治疗牙周骨内缺损方面疗效显著[5-6]。根分叉病变是导致磨牙早失的重要原因之一，也是目前牙周病学领域急需攻克的一大难题。研究证实，与单根牙相比，根分叉病变的多根牙附着丧失更广泛，非手术治疗疗效不佳[7-8]。如何实现根分叉病变的完全闭合一直是学者们研究的热点。研究表明，磨牙Ⅱ度根分叉病变比较有效的再生治疗方法是植骨术与引导性组织再生术[9-10]，但完全治愈率仍需提高。

随着口腔显微镜在临床中的应用以及显微器械和手术技术的发展，显微口腔治疗已广泛应用于牙体牙髓病、口腔种植、修复及牙周病诊疗[11-12]。研究表明，显微镜辅助下的牙周基础治疗较普通视野下治疗能取得更好的远期临床疗效和舒适度[13]。传统牙周手术易造成组织损伤，影响伤口愈合，对术后恢复产生不利影响。国外学者采用血管荧光造影技术，比较裸眼手术和显微手术对牙周软组织的影响，结果显示显微外科组术后的血管化程度显著提高[14]，显微牙周手术还能促进牙周骨缺损再生[15]，但其对根分叉病变的疗

效尚不明确。本研究拟探讨口腔显微镜辅助微翻瓣牙周植骨术与裸眼常规手术治疗下颌磨牙Ⅱ度根分叉病变的疗效差异，以期为根分叉病变的再生治疗提供新思路与方法。

1　资料和方法

1.1　研究对象

本研究获得中山市口腔医院医学伦理委员会的批准（伦理审查号：K2022-127），所有患者均同意治疗且签署知情同意书。选取2022年1月至2023年12月于本院牙周病科就诊的56例牙周炎患者，经牙周基础治疗后6周复查探诊深度＞5 mm伴Ⅱ度根分叉病变的下颌磨牙共60颗纳入本研究，采用随机数字表法分为试验组和对照组，每组各30颗患牙。本研究的纳入标准为：①年龄≥18岁；②根据2018年牙周病和种植体周病国际新分类[16]诊断为牙周炎者；③完善牙周基础治疗后，根分叉区垂直探诊深度＞5 mm，Ⅱ度根分叉病变（Glickman分类）[17]的下颌磨牙；④患者无全身系统性疾病且能耐受牙周手术。排除标准：①近6个月内接受过牙周手术治疗者；②患牙牙髓活力异常或已接受牙髓治疗者；③妊娠期和哺乳期妇女；④有严重全身疾病者；⑤吸烟；⑥牙体组织龋坏、缺损、劈裂；⑦患牙存在咬合创伤且不能通过调整咬合或固定改善者；⑧不能耐受牙周手术者。

1.2　手术方法

对照组采用内斜切口及垂直切口翻瓣，裸眼行牙周翻瓣植骨手术；试验组则在口腔显微镜辅助下，行无垂直切口的微翻瓣牙周植骨手术。具体手术操作：①试验组在口腔手术显微镜（OMS2380，Zumax，中国）下，用显微牙周器械在患牙根分叉病变侧沿龈缘行沟内切口，以骨缺损为中心作潜行分离，延伸至骨缺损外3 mm，超出近远中轴角处则保留龈乳头，行隧道分离，在显微镜下彻底清除根分叉病灶区龈下牙石、菌斑及肉芽组织。②对照组沿患侧及邻近一颗牙齿的龈缘处作沟内切口，选择邻牙同侧远中处作垂直切口，形成常规“L”形切口，翻开黏骨膜瓣至骨缺损外3 mm，离断一侧邻牙龈乳头，直视下行根分叉区清创。两组均植入小颗粒骨替代材料（Bio-Oss，Geistlich，瑞士）和可吸收生物膜（骨膜C型，海奥，中国），5-0缝线关闭创口，术后2周拆线。其中试验组使用口腔显微镜辅助微翻瓣牙周植骨术的典型病例见图1。

1.3　评价指标

1.3.1　牙周临床指标　在术前和术后6个月时分别对两组患者进行临床检查。术前和术后的临床检查均由同一名牙周科医师进行，检查者对分组情况不知晓，研究开始前对检查者进行自身一致性检验。检查指标：①探诊深度（probing depth，PD）：龈缘至龈沟底的距离，单位为mm。②出血指数（bleeding index，BI）：结合探诊、视诊检查龈缘区进行评分：0 = 牙龈健康；1 = 牙龈颜色有炎症改变，探诊不出血；2 = 探诊后点状出血；3 = 探诊出血沿牙龈缘扩散；4 = 出血流满并溢出龈沟；5 = 自动出血。③牙龈退缩（gingival recession，GR）：龈缘至釉牙骨质界的距离，单位为mm。

1.3.2　垂直骨高度增加量　采用锥形束CT（cone beam CT，CBCT）检查测术区术后6个月垂直骨高度增加量（vertical bond height increment，VBHI），测量方法见图2。

1.3.3　疼痛程度　使用视觉模拟评分法（visual analogue scale，VAS）分别评估两组术后4、24、48 h的疼痛度，患者于标有10 cm横线卡纸上据疼痛程度标记，其中0为无痛、10为剧痛，1 cm为1分，总分10分，分值高代表疼痛越剧烈。

1.3.4　术后并发症　记录术后6个月有无牙齿敏感、牙髓炎、牙周脓肿、膜暴露、骨坏死等并发症。

1.4　统计学分析

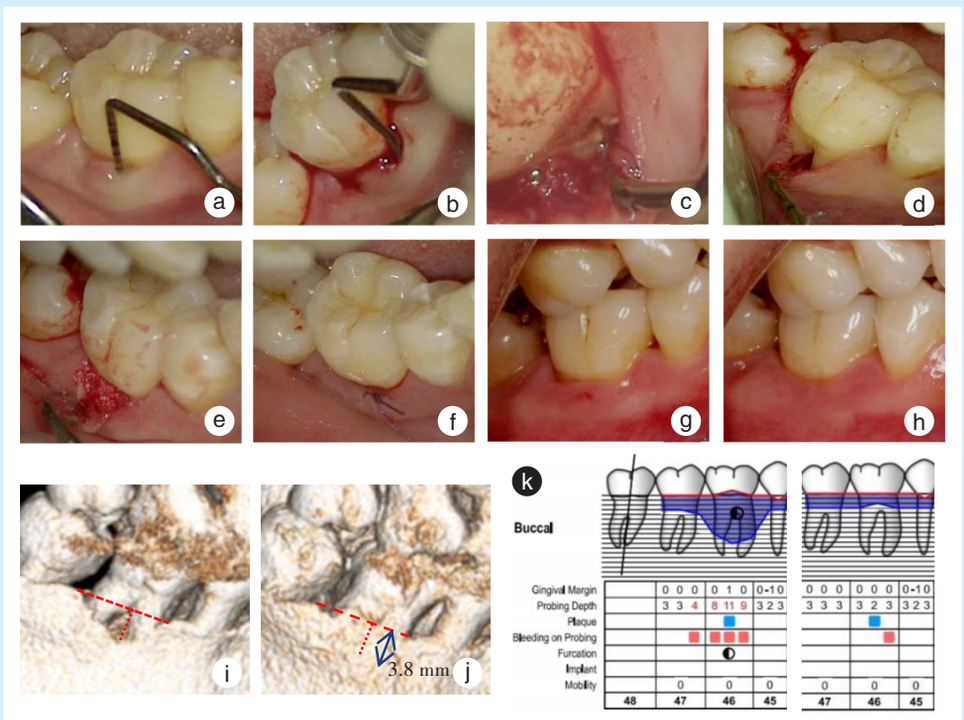
采用SPSS27.0软件进行统计学分析。计量资料以$\bar{x} \pm s$表示，两两比较采用独立样本t检验，计数资料以率表示，组间进行χ^2检验，P<0.05表示差异具有统计学意义。

2　结　果

2.1　两组治疗前后的牙周临床指标及垂直骨高度增加量的比较

本研究纳入对照组30例，患牙30颗，男性16例，女性14例，年龄（50.40±9.14）岁；试验组26例，患牙30颗，男性13例，女性13例，年龄（50.85±10.09）岁，两组患者一般资料及术前各临床指标无统计学差异，资料具有可比性（P>0.05）。

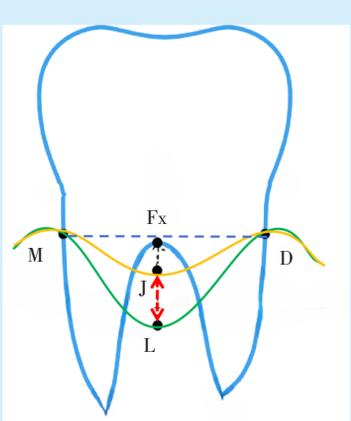
组内治疗前后对比，两组在术后6个月PD、BI较术前均有改善，对照组PD由术前（7.33±1.72）mm到术后6个月（3.37±0.96）mm（P<0.001），试验组PD由术前（7.27±1.57）mm到术后（3.00±0.69）mm（P<0.001）；对照组BI由术前3.03±1.03到术后0.77±0.82（P<0.001），试验组BI由术前3.20±1.09到术后



A 32-year-old female patient presented with the chief complaint of recurrent gingival swelling and discomfort in the left posterior teeth for six months. She was diagnosed with periodontitis (Stage III, Grade B, localized). Six weeks after initial periodontal therapy, the patient underwent microsurgical flap periodontal bone grafting assisted by a dental operating microscope to treat a Class II furcation defect in the left mandibular first molar. a: preoperative probing, PD=11 mm; b: minimally invasive flap via intrasulcular incision; c: subgingival calculus in furcation area exposed under a dental microscope; d: debridement completed; e: Bio-Oss bone graft implanted; f: immediate postoperative view; g: suture removal at 2 weeks post-surgery, with the surgical site healing well; h: 6 months post-surgery, with no gingival recession observed; i: pre-surgery CBCT; j: CBCT at 6 months post-surgery; k: periodontal probing chart of teeth 45 – 47 (left: pre-surgery; right: post-surgery)

Figure 1　Microsurgical flap periodontal bone grafting assisted by a dental operating microscope

图1　口腔显微镜辅助微翻瓣牙周植骨术



M: bottom of the mesial bone defect; D: the bottom of the distal bone defect; Fx: apex of furcation fornix; L: the lowest point of bone loss in the furcation area pre-treatment; J: the lowest point of bone loss in the furcation area post-treatment; Green line (M-L-D): pre-treatment alveolar bone level; Yellow line (M-J-D): post-treatment alveolar bone level; Fx-L: pre-treatment vertical bone loss; Fx-J: post-treatment vertical bone loss; red arrow line segment (L-J): vertical bone height increment (mm) = Fx-L – Fx-J

Figure 2　Measurement method for vertical bone height increment

图2　垂直骨高度增加量测量方法

0.73±0.64（P<0.001），差异均具有统计学意义。试验组在治疗后6个月GR较术前明显改善，差异具有统计学意义（P=0.007），而对照组术后GR（1.37±0.89）mm较术前（1.13±0.97）mm增加，但差异无统计学意义（P=0.337）。见表1。

术后6个月组间对比，试验组GR低于对照组，差异有统计学意义（P=0.001）。试验组PD、BI与对照组相比差异均无统计学意义（PD：P=0.096，BI：P=0.861）。

术后6个月，试验组VBHI为（3.50±0.900）mm，对照组为（3.13±0.937）mm，两组比较差异无统计学意义（P=0.128）。见表1。

2.2　两组患者治疗后疼痛程度比较

用VAS法记录试验组与对照组术后4、24、48 h的疼痛度，记录疼痛分值。试验组术后4、24 h的疼痛程度显著低于对照组，差异有统计学意义（P<0.001）。见表2。

2.3　术后并发症

术后6个月随访，所有患者均未出现牙齿敏感、牙髓炎、牙周脓肿、膜暴露、骨坏死等并发症。

表1　两组治疗前后的牙周临床指标(探诊深度、出血指数、牙龈退缩)及垂直骨高度增加量比较

Table 1　Comparison of periodontal clinical indicators (probing depth, bleeding index, gingival recession) and vertical bone height increment between the two groups before and after treatment　$\bar{x} \pm s$

Index	Time	Control group (n=30)	Experimental group (n=30)	t	P
Probing depth / mm	T0	7.33 ± 1.72	7.27 ± 1.57	0.178	0.860
	T1	3.37 ± 0.96	3.00 ± 0.69	1.69	0.096
	t	13.279	13.581		
	P	<0.001	<0.001		
Bleeding index	T0	3.03 ± 1.03	3.20 ± 1.09	−0.606	0.547
	T1	0.77 ± 0.82	0.73 ± 0.64	0.176	0.861
	t	9.424	10.65		
	P	<0.001	<0.001		
Gingival recession / mm	T0	1.13 ± 0.97	1.26 ± 0.94	−0.539	0.592
	T1	1.37 ± 0.89	0.70 ± 0.59	3.409	0.001
	t	−0.969	2.779		
	P	0.337	0.007		
Vertical bond height increment / mm	T0	−	−		
	T1	3.13 ± 0.937	3.50 ± 0.900	−1.546	0.128

T0: before treatment; T1: 6 months after treatment. Control group: underwent periodontal flap surgery with an internal oblique incision and vertical incision (a microscope was not used for this procedure); experimental group: underwent microflap periodontal bone grafting surgery without vertical incision (an oral microscope was used for this procedure)

表2　两组患者治疗后疼痛程度VAS评分比较

Table 2　Comparison of postoperative pain VAS score between two groups after treatment　$\bar{x} \pm s$

Time after treatment	Control group (n=30)	Experimental group (n=30)	t	P
4 h	5.36 ± 0.51	3.86 ± 0.35	10.663	<0.001
24 h	2.15 ± 0.32	1.75 ± 0.19	4.742	<0.001
48 h	1.39 ± 0.12	1.35 ± 0.11	1.072	0.291

Control group: underwent periodontal flap surgery with an internal oblique incision and vertical incision (a microscope was not used for this procedure); experimental group: underwent microflap periodontal bone grafting surgery without vertical incision (an oral microscope was used for this procedure). VAS: visual analog scale

3　讨　论

根分叉病变是指牙周炎病变累及多根牙根分叉区,在该处出现牙周袋、附着丧失和牙槽骨吸收。根分叉区解剖结构复杂(如根面凹陷、釉质突起等),易形成菌斑滞留区,促进牙周附着丧失[18]。根分叉病变磨牙的失牙率远高于正常磨牙[19],其治疗一直是牙周再生领域的难点[20]。研究证实,根分叉病变患牙的非手术治疗效果欠佳[21]。目前,磨牙Ⅱ度根分叉病变较为有效的治疗方法是牙周植骨术与引导性组织再生术[7, 22]。牙周植骨术是采用骨或骨替代物等移植材料修复因牙周炎造成的牙槽骨缺损的一种手术疗法[23]。根分叉病变因解剖结构复杂、菌斑控制困难,传统手术治疗面临成骨效率低、术后牙龈退缩等挑战。本研究将显微外科技术与微创翻瓣植骨术联合可吸收胶原膜相结合,在实现高效骨再生的同时显著改善术后美学和功能结局,有望为临床提供了更优解决方案。本研究结果显示,两组术后6个月PD、BI等牙周临床指标较术前均有改善;两组术后VBHI增加量均在3 mm以上,提示牙周植骨术在治疗下颌磨牙Ⅱ度根分叉病变的成骨效果显著,与既往的研究结果一致。

大量研究表明,牙周翻瓣术虽能改善PD、BI、临床附着水平(clinical attachment level,CAL)等牙周参数,但术后可能会导致牙龈退缩[24-25]。本研究中,部分患者植骨术前已出现牙龈退缩的状况,提高牙龈退缩患牙的根面覆盖率是治疗的关键之一。本研究中手术通过微创切口设计、术区软组织充分减张以及覆盖生物膜以增厚软组织等一系列操作,减少手术本身所造成的牙龈进一步退缩,并达到一定程度的改善。Chavan等[24]通过临床研究发现,在翻瓣术中联合使用脱细胞真皮基质

（acelluar dermal matrix，ADM）可有效减少牙龈退缩，提高牙周临床参数。研究表明，可吸收胶原膜能有效维持血凝块的稳定性，采用可吸胶原膜行GTR可改善牙龈退缩[26]。GTR的原理是借助膜状材料提供物理性屏障，阻挡结合上皮向根方生长，使牙周膜细胞优先占据根面，促进新附着形成，实现牙周组织再生[27]。Irokawa等[28]的研究表明，可吸收胶原膜与脱矿冻干骨联合治疗骨下袋取得了较好的长期临床疗效。Pajnigara等[29]的一项随机对照临床研究显示，采用胶原膜的GTR可有效提高脱矿冻干骨治疗Ⅱ度根分叉病变的临床效果和影像学效果。本研究联用骨移植材料与可吸收胶原膜，构建“三维再生空间”，胶原膜的物理屏障作用显著延缓上皮迁移，促进牙周膜细胞定向分化，术后6个月垂直骨高度增加，且未发生膜暴露或感染并发症，以上结果证明其具有良好的安全性及成骨效能。

显微外科的应用对牙周手术疗效存在积极意义，在传统牙周手术中，医师对创口定位及操作精细度的把控有限，容易增加术中创面扩大、软组织撕裂等非必要损伤的风险以及术后伤口肿胀、感染等并发症的可能性[30]。在口腔显微镜的放大和照明辅助下，显微镜可调节的放大作用和光线强度，显著增强了术者的视觉敏感度，术者手眼协同操作能力得以提升，能有效提高操作精度，提高疗效[31]。Burkhardt等[14]研究表明，与传统手术相比，显微外科术后7 d时牙周软组织的血管化程度增加约20%。显微镜辅助根面覆盖术能有效提高牙龈退缩患牙的根面覆盖率，其美学指数优于传统手术[32-33]。此外，显微外科技术能有效改善植骨术后的临床参数，促进骨再生[34-35]。多项研究证实，显微外科能减少组织损伤，提高舒适度，减少并发症[14, 32, 36-37]。本研究中，对照组术后6个月GR与术前对比略有增加，虽差异无统计学意义，但提示传统的翻瓣手术方式仍可能导致一定程度的牙龈退缩。试验组引入口腔显微镜辅助操作，使用口腔显微镜在高倍镜头下实施清创，能更为清晰地观察根分叉区的微小牙石，达到更佳的清创目的[30, 38]。另外，使用微创的翻瓣术式，能减少垂直切口造成对组织瓣血供的影响，对术后组织瓣的愈合再生提供更为有利的条件，并减少牙龈退缩。微创翻瓣设计减少垂直切口对血供的破坏，组织瓣存活率提高，术后6个月试验组牙GR较对照组降低49%，验证了显微技术对软组织保留的独特优势[14]。但口腔显微镜早期学习的时间成本较高，术者需改变裸眼操作习惯，适应镜下视野及操作方式，对医师的学习及操作能力有一定的要求，难以全面推广。

值得注意的是，本研究两组在术后6个月垂直骨高度均有增加，且统计学上无明显差异，但对照组中术后6个月的GR数值较术前增加，而试验组GR数值则减少，且两组的差异具有统计学意义，治疗结果似乎相矛盾，究其原因，可能是因为：牙龈附着于牙槽骨表面，牙槽骨高度一定程度上决定牙龈高度，但不能忽略牙龈表型对牙龈附着高度的影响。对照组在翻瓣清创过程中，可能会对牙周袋内壁的肉芽组织及上皮下结缔组织过度清除，导致一定程度上牙龈厚度变薄，加之垂直切口的使用，可能进一步加重术后牙龈退缩，即使牙槽骨高度增加，但仍无法避免牙龈退缩；而试验组在显微镜的辅助下，清创更为精准，对于牙龈上皮下结缔组织的保护更佳，一定程度上保障牙龈厚度，在牙槽骨高度增加的同时牙龈附着高度也获得一定程度的增加，两组术后GR的差异，可能是术后嵴顶上结缔组织厚度的差异，故出现上述结果。

在手术舒适度与术后并发症方面，微创术式显著降低术后创伤反应；随访期间所有患者均未发生牙髓炎、牙周脓肿、膜暴露、骨坏死等严重并发症[39]。上述结果与既往研究相似，提示显微外科能提高牙周手术疗效，显著降低患者术后疼痛程度，改善口腔健康相关生活质量。

本研究局限性在于样本量较小且随访时间较短，未来需扩大样本并延长观察周期以评估长期疗效。此外，本研究只观察了GR、PD及BI等临床指标，未对CAL、松动度等指标进行评估和分析，后续将进一步完善各项牙周临床指标的观察和分析，若能结合龈沟液中炎症因子、菌斑成分分析等基础研究，或将能更全面客观地评价疗效。另外，本研究亦未对牙周袋植骨材料及可吸收膜的类型进行亚组分析，后续研究可进一步探讨不同生物材料与显微技术的协同效应。

未来将通过多中心随机对照试验延长随访，并整合龈沟液炎症因子动态监测，进一步解析“显微—材料—生物学”协同机制。同时，关注新型植骨材料如脱矿牙本质基质[40-41]、个性化胶原膜/植骨材料复合体[42-43]等的研发，进一步实现分叉区解剖形态的仿生重建。

综上所述，口腔显微镜辅助下微翻瓣牙周植

骨术治疗下颌磨牙Ⅱ度根分叉病变，植骨成功率高，且安全性高，能显著降低患者术后疼痛程度，减小牙龈退缩，未来需结合多中心研究及长期随访数据，进一步验证其临床推广价值。

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