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·防治实践·

早萌上颌前磨牙慢性根尖周炎再生性牙髓治疗1例及文献回顾

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【摘要】 **目的**　探讨早萌上颌前磨牙慢性根尖周炎的治疗方法，为早萌年轻恒牙根尖周炎的治疗提供参考。**方法**　对1例早萌Nolla Ⅶ期左上颌第一前磨牙慢性根尖周炎患者患牙通过规范的根管冲洗、根管消毒行再生性牙髓治疗，严密冠方封闭，并随访；同时对相关文献进行回顾分析。**结果**　该病例患牙的临床症状消失，并且牙根继续发育，随访20个月，患牙生物学功能得到有效恢复。文献回顾分析表明，早萌年轻恒牙根尖周感染主要与牙髓暴露和细菌感染有关，少有逆行性感染。牙髓坏死年轻恒牙的治疗优先选择再生性牙髓治疗以促进根尖闭合，而再生性牙髓治疗的关键环节包括彻底消毒、诱导出血和严密封闭以促进干细胞增殖分化。**结论**　再生性牙髓治疗是早萌年轻恒牙慢性根尖周炎的理想治疗方式。

【关键词】 早萌；　年轻恒牙；　Nolla Ⅶ期；　前磨牙；　慢性根尖周炎；　再生性牙髓治疗；　根管消毒；　冠方封闭
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Regenerative endodontic procedures for a prematurely erupted maxillary premolar with immature roots and chronic apical periodontitis: a case report and literature review

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【Abstract】 **Objective**　To investigate treatment strategies for chronic periapical periodontitis in prematurely erupted premolars and provide guidance for managing pulp and periapical diseases in young permanent teeth with immature roots. **Methods**　A regenerative endodontic procedure (REP) was performed on a prematurely erupted maxillary left first premolar (tooth 24) at Nolla stage Ⅶ with chronic apical periodontitis, following standardized protocols including root canal irrigation, disinfection, and coronal sealing. The case was followed up, and a literature review was conducted. **Results**　Clinical resolution of symptoms was observed on tooth 24, with sustained root development. After a 20-month follow-up, the tooth had restored biological function. Literature synthesis revealed that periapical infections in prematurely erupted permanent teeth predominently arise from pulp exposure and bacterial infection, with retrograde infection being rare. For young permanent teeth with necrotic pulp, regenerative endodontic procedures has been established as the treatment of choice to promote apical closure and root maturation. The critical steps of regenerative endodontic procedures include thorough disinfection, induced bleeding to form a fibrin scaffold, and coronal sealing to facilitate stem cell recruitment and differentiation. **Conclusion**　Regenerative endodontic procedures represents an effective and viable treatment option for prematurely erupted young permanent teeth with chronic periapical periodontitis.

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【Key words】 premature eruption; young permanent teeth; Nolla stage Ⅶ; premolar; chronic periapical periodontitis; regenerative endodontic procedures; root canal disinfection; coronal sealing
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恒牙早萌是指牙齿萌出时间过早,通常伴有牙根发育不足的现象,多见于前磨牙[1],国外文献报道前磨牙早萌患病率约为5%[2]。早萌恒牙因牙根短,缺少牙槽骨支持,极度松动,伴发牙髓感染后治疗难度大,尤其是牙髓坏死累及根尖周组织的患牙。根尖诱导成形术是治疗年轻恒牙牙髓坏死的传统方法,虽然其临床成功率较高,但很难获得牙根的继续发育[3-4]。再生性牙髓治疗(regenerative endodontic procedures,REPs)通过有效的根管消毒,保护牙髓干细胞、根尖乳头干细胞等种子细胞,提供再生支架及生长因子,诱导干细胞迁移和分化生成修复性组织,不仅可改善临床症状,而且能重建牙髓-牙本质复合物体功能,促进感染的年轻恒牙牙根继续发育[5]。自2001年Iwaya等[6]运用再生性牙髓治疗成功诱导了1例患有根尖周炎的年轻恒牙牙根继续发育以来,该方法被越来越多地应用于牙髓坏死年轻恒牙的治疗,尤其在牙根长度明显不足病例中疗效显著[7-8],是早萌恒牙伴发感染后理想的治疗方式。本文报道早萌上颌第一前磨牙不明原因根尖周炎1例,经再生性牙髓治疗后,随访20个月,患牙生物学功能得到有效恢复,可望长期行使功能。

1　病例资料

1.1　临床检查

患儿,男,10岁,主诉"左上后牙咬合痛2周"就诊。现病史:2周来患儿自觉左上后牙自发痛、咬合痛,1周前感冒发烧,伴发牙龈肿胀。既往体健,否认药物过敏史及其他病史。口腔检查:颌面部检查未见明显异常。口腔卫生尚可,混合牙列,53、54、55、65、74、75、84、85未脱落。24萌出,未见发育畸形及龋坏,叩痛(+),松动Ⅱ度,冷热测均无反应,腭侧牙龈偏远中近龈缘处有一3 mm×5 mm肿胀区,无咬合创伤。X线示:24牙根短小,根尖呈喇叭口开放状,根尖周低密度影像(图1a)。65近中𬌗面腭侧深龋坏,探不敏感,叩痛(-),无病理松动,牙龈未见明显异常。为明确诊断,插入诊断牙胶尖示踪:炎症来源于24根尖区(图1b)。

诊断:24慢性根尖周炎,恒牙早萌;65深龋。治疗计划:24行再生性牙髓治疗术;65树脂充填术。治疗过程:家长知情同意治疗24,要求65暂缓治疗。

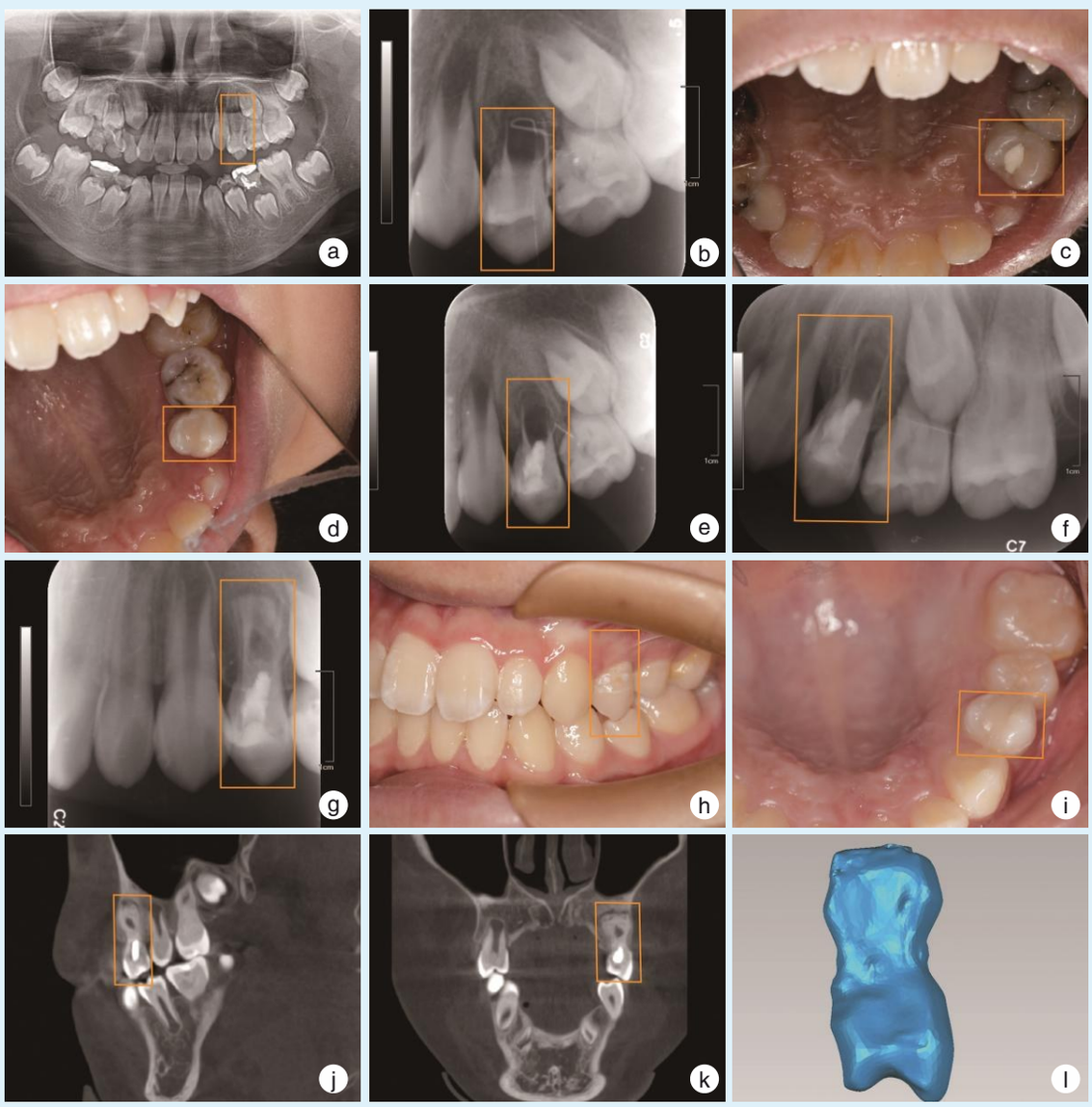
1.2　治疗经过及随访

24上橡皮障,开髓,揭髓室顶,可见弥漫性炎性血液渗出,未见成形牙髓,清理髓腔,1%次氯酸钠(20 mL)和0.9%氯化钠溶液(10 mL)交替冲洗根管,吸潮纸尖擦干根管,螺旋输送器导入氢氧化钙,暂封。患儿术后1周复诊,24无自觉症状,叩痛(±),腭侧牙龈状态明显好转(图1c),根管内未见明显渗出,冲洗擦干后封氢氧化钙,暂封。术后3周复诊,24无自觉症状,叩痛(-),I度松动,腭侧牙龈恢复正常,因髓腔内渗出较多,继续行根管内换药。5周后复诊,24无自觉症状,叩痛(-),无病理松动,窦道消失,牙龈无异常。24橡皮障隔湿下,去净暂封及根管内氢氧化钙,1%次氯酸钠(20 mL)和0.9%氯化钠溶液(10 mL)交替冲洗根管,超声主动、被动荡洗,纸尖干燥,显微镜下使用40# K锉刺破根尖,可见血液弥散充满至根管口,iRoot BP Plus轻置于根管口,玻璃离子水门汀垫底,复合树脂(Filtek Z350 XT,3M ESPE,美国)严密充填。术后拍摄口内照和根尖片,X线片示可见24根管上段高密度充填物影像,冠方充填严密,根尖低密度影范围较初诊时缩小(图1d、1e)。

随访情况:术后1个月随访,X线片示24牙根继续发育,长度增加,有硬组织形成,根尖低密度影进一步缩小(图1f)。患儿术后6个月复诊,X线片示:24牙根长度继续,根管壁可见增厚,硬组织增厚不均匀,形态欠佳,根尖低密度影缩小(图1g)。术后20个月随访:24牙冠部充填完好,牙冠光亮,冷热测无反应,牙髓电活力测平均值为53,与对侧同名牙平均值31相比较迟钝,牙龈未见异

常(图1h、1i)。

术后20个月CBCT及三维重建结果示:24牙根增长,根管壁增厚,根尖闭合,牙根形态不规则(图1j~1l)。



a: tooth 24 at Nolla stage Ⅶ with periapical radiolucency; b: diagnostic gutta-percha point tracing confirms that inflammation originated from tooth 24; c: 1-week follow-up shows no obvious gingiva swelling on the palatal site of tooth 24; d: immediate postoperative intraoral view of tooth 24 shows no obvious gingiva swelling on the palatal site; e: immediate postoperative periapical radiograph of tooth 24 shows a reduction in the size of periapical radiolucency compared to the baseline; f: 1-month follow-up periapical radiograph shows continued root development; g: 6-month follow-up radiograph demonstrates root canal wall thickening; h&i: 20-month intraoral views show restored crown luster; j&k: 20-month CBCT scans confirm root canal wall thickening; l: 3D reconstruction at 20 months reveals irregular root morphology. The orange box highlights radiographic and clinical changes

Figure 1　Radiogragh examination and intraoral photographs of an early erupted tooth 24 with chronic periapical periodontitis (March 2022-November 2023)

图1　早萌24牙慢性根尖周炎影像学检查及口内照(2022年3月-2023年11月)

2　讨　论

2.1　早萌恒牙根尖周感染的病因分析

恒牙早萌分为全口早萌和个别早萌两种类型。在临床上全口恒牙早萌极为少见,病因主要与内分泌失调和遗传性疾病相关。相比之下,个别恒牙早萌更为常见,且临床表现多样。文献报

道，多数恒牙早萌是由于乳牙严重根尖周感染导致[9]，这可能是因为炎症刺激破骨细胞活跃，加速乳牙牙根吸收，恒牙因失去萌出阻力而过早萌出。有研究报告指出，根尖周炎症区域能够释放细胞因子，促进局部骨吸收，为继承恒牙胚形成异常萌出通道[10]，在本病例中，问诊可知患儿左上第一乳磨牙因龋早失，结合患儿口内其他患牙情况，推测早失左上第一乳磨牙脱落原因为根尖周炎，这可能是导致左上第一前磨牙早萌的病因。文献报道，乳牙根尖周炎和外伤等可导致继承恒牙形态异常及矿化不良[11-12]，早萌于口腔后极易发生龋坏，进而发展为牙髓炎及根尖周炎[13]。本病例中，早萌左上第一前磨牙并无龋坏、发育异常及外伤史，却并发严重根尖周感染，推测原因有二：一是早萌恒牙牙根尚未发育完成，牙周组织薄弱，发生逆行性感染；二是早萌患牙牙根短，即使承受正常的咬合力，也可能导致其发生创伤性损害。因此在临床检查中，若发现早萌恒牙，应及时采取干预措施，以防出现严重并发症。

2.2　牙髓坏死的年轻恒牙治疗方法选择

目前，临床上出现年轻恒牙牙髓坏死后的主要治疗方法有根尖诱导成形术、根尖屏障术和再生性牙髓治疗三种。最早出现且应用最广的是根尖诱导成形术，但不同牙齿经药物诱导的根尖愈合方式存在一定差异，多数病例仅在根尖区形成钙化屏障，较少见牙根的延长和根管壁的增厚，牙齿残留的牙本质壁薄且脆弱，术后易发生折断及劈裂[4，14]，除此之外，根尖诱导成形术治疗时间长，复诊次数多，患者的依从性难以控制，这些因素都影响患牙的预后。相较于根尖诱导成形术，根尖屏障术可有效缩短疗程、减少患者就诊次数、根尖硬组织屏障即刻形成、生物性封闭性能好、能避免长期放置氢氧化钙导致的牙本质强度削弱及根折的发生，但该技术不能促进牙根进一步发育，特别是对于牙根发育较短的早萌恒牙，术后可能出现冠根比例失调，影响后续修复治疗的效果[15-17]。

随着再生医学与牙髓生物学的发展，再生性牙髓治疗应运而生，现代再生性牙髓治疗甚至涵盖细胞归巢和自体干细胞移植等多种技术[18-20]。该技术主要用于治疗年轻恒牙的牙髓病变，其核心步骤包括清除髓腔和根管系统中的炎症组织，随后通过器械刺激根尖区域，促使血液流入并充盈根管[20]。这一过程形成的血凝块为牙髓再生提供了支架，血液和根管内壁释放出细胞因子，根尖周残余的牙乳头提供了修复性干细胞，进而促进牙根的进一步发育[19，21]。多项临床研究和病例报告表明，牙髓再生性治疗在年轻恒牙的治疗中取得了显著效果，牙根结构得到有效保护，牙根长度和根管壁厚度得以增加，冠根比获得显著改善，同时咬合力也得到显著增强[22]。在本病例中，早萌左上第一前磨牙牙根发育仅为Nolla Ⅶ期[23]，牙根长度明显不足，根管壁薄且脆弱，若使用根尖诱导成形术，术后发生劈裂和牙根折断的可能性极大；而根尖屏障术不能促进牙根发育，该患牙冠根比例严重失调，亦无法为后期修复提供良好条件；根据患牙的病因、牙体的自身情况、牙齿所在位置和患者的需求等综合评估，再生性牙髓治疗作为首选诊疗方案，经过20个月的随访，该患牙临床症状消失，牙根继续发育，取得了良好的临床效果。

2.3　再生性牙髓治疗的重要环节

再生性牙髓治疗的原理依托于组织工程的关键因素：具有多向分化潜能的间充质细胞、调控细胞增殖分化的生物活性信号分子以及提供三维生长环境的生物材料基质[24-25]。要想保证治疗的成功率，三要素缺一不可。在本病例中，通过穿刺根尖促使血液流入根管，形成支架结构，同时引导根尖周围组织中的间充质干细胞进入根管，成为牙髓再生的种子细胞。另有研究表明，即便在牙髓坏死并发根尖周炎或脓肿的情况下，根尖部位仍可能保留部分关键的牙髓组织，这些组织可作为牙髓修复或再生的细胞来源[26-27]。根管内血凝块支架本身就含有一定的生长因子[24，28]，此外，根管冲洗以及根管消毒药物可以使牙本质基质暴露，促进其中的生长因子释放，有利于促进根管壁新组织的附着[27，29]。本病例中应用的根管冲洗和消毒药物为1%次氯酸钠和氢氧化钙，有研究发现氢氧化钙对于根尖乳头干细胞的增殖具有良好的促进作用，当根尖乳头干细胞暴露于不同浓度的氢氧化钙下，干细胞不仅未出现半数致死现象，甚至还出现了倍数增长[29]；在Jamshidi等[30]的研究中，氢氧化钙糊剂相较于抗生素糊剂细胞毒性低，遗传毒性低，这也体现了氢氧化钙糊剂更高的安全性及综合优势。研究表明，1%次氯酸钠既能达到良好的抗菌效果，对根尖组织也相对无毒害，而高浓度的次氯酸钠具有明显的细胞毒性[31-32]。另有研究显示，根管消毒时超声波荡洗效果优于声波冲洗和冲洗器冲洗[33-34]，因此，在本病例中为了达到理想的冲洗消毒目的，采用了1%次氯酸钠配合

超声进行主动和被动荡洗，氢氧化钙糊剂进行封药，为保留患牙以及促进牙根继续发育提供了有利支持。此外，严密的冠方封闭、避免根管再感染是保障再生性牙髓治疗成功的又一关键因素，本病例选择iRoot BP Plus作为患牙冠方封闭材料，iRoot BP Plus同根管壁间既有物理性连接，又有化学性连接，有助于进一步降低微渗漏、提高封闭性，根据临床研究数据，iRoot BP plus材料在年轻恒牙根尖感染的牙髓血运重建治疗中展现出显著疗效，不仅能改善患者的临床症状，还能促进根管壁增厚及牙根长度增加[35-36]。

综上，早萌年轻恒牙并发根尖周感染时，通过积极的根管冲洗、根管消毒，运用再生性牙髓治疗，辅以严密的冠方封闭，可以有效控制感染，促进早萌牙牙根继续发育，实现其长期存留并正常行使功能的目标，值得临床进一步推广与研究。

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