

# 脊柱内镜技术的新进展

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## 摘要

近年来, 微创器械的不断开发以及内镜技术的不断创新, 使得脊柱内镜下的微创手术在临床上得到了广泛的应用, 也成为了当前脊柱外科的研究热点。本文介绍了常见的脊柱内镜系统, 围绕颈、胸、腰椎这些部位, 来阐述目前脊柱内镜系统在临床上的常见术式应用和未来展望。

## 关键词

脊柱内镜, 内镜手术, 微创脊柱手术, 经皮脊柱手术

# New Advances in Spinal Endoscopic Techniques

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## Abstract

In recent years, the continuous development of minimally invasive instruments and the continuous innovation of endoscopic technology have made the minimally invasive surgery under the spinal endoscope widely used in clinical practice, and it has also become a research hotspot in current spinal surgery. This article introduces the common spinal endoscopic systems, focusing on the cervical, thoracic, and lumbar spine, to describe the current clinical applications and future prospects of spinal endoscopic systems.

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## Keywords

**Spinal Endoscopic Technique, Endoscopic Surgery, Minimally Invasive Spine Surgery, Percutaneous Spinal Surgery**

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## 1. 引言

近年来, 随着社会经济的高速发展, 医疗科技的进步在临床上发生了质的飞跃, 这给人类疾病诊疗带来了更多的福音。有许多文献报道[1]显微内镜的应用在不同系统疾病中涉及颇为广泛, 尤以消化系统[2]、呼吸系统[3]、泌尿系统[4]为代表居多。回顾过去, 1922年, Adson首次描述了用手术切除突出的髓核[5]。1934年, Mixer和Barr首次报道了外科手术切除突出椎间盘病例, 被认为是第一个椎间盘外科医生[5][6]。但这些都是开放性手术。上世纪40年代, Valls和Craig阐述了椎体的后外侧入路[7][8], 并且Craig[9]使用一套小内径穿刺套管将椎体活检。1973年, Kambin利用Craig套管从侧方椎间盘入路着手, 进行第一次经皮减压和椎间盘切除术[10]。随着研究的深入, 一个新的区域“Kambin三角”[11]的概念被提出来, 1997年, Yeung应用了关节内窥镜的原理引入了多通道广角内窥镜系统[12], 被命名为YESS (Yeung Endoscopic Spine System)。后来Hoogland提出了THESSYS (Thomas Hoogland Endoscopic Spine System)系统, 提供了范围最广的同轴内窥镜和可变长度及直径的内窥镜[13]。此后, 脊柱内镜得到不断发展和创新。随着微创脊柱手术[14] (minimally invasive spine surgery, MISS)概念的提出, MISS就逐渐成为了脊柱医学的主流概念。长期出现颈部疼痛、背痛或下腰痛会使患者选择手术治疗, 而脊柱疾病手术常规包括减压手术或联合以及不联合融合手术, 为了在手术过程中最大程度的减少正常组织受损, 并且达到相同或更佳的治疗效果, 凸显了MISS的必要性, 这也大大的降低了围手术期的并发症, 以及降低了手术后的恢复时间[15]。

## 2. 常见的脊柱内镜系统介绍

现如今内镜系统突飞猛进, 但主要有以下三种内视镜系统: 显微内窥镜系统、单通道内视镜系统、双通道内视镜系统。利用这些精密的内视镜系统及精细的外科操作, 可以最大程度地减少开放手术所带来大切口、正常软组织及骨或软骨组织的损伤、出血量大、术后主观疼痛增加、及术后感染风险, 可以有效地保留了正常脊柱的稳定降低退变风险, 维持脊柱的平衡。

### 2.1. 显微内窥镜系统

显微内窥镜系统最常用的是METRx管组件。它是将显微内窥镜与含有组织扩张器的管状牵开器所连接, 这样可以有效的减少肌肉收缩[16][17]。有别于其他内窥镜系统, 它不使用持续的盐水冲洗。在实际工作中, 它经常被用作使用管状牵开器系统而不是内窥镜组件的微创显微镜手术[14]。相对于单或双通道内视镜系统, 显微内窥镜系统应用较宽广, 操作较简单, 但是不足的是由于此系统与我们传统手术的方式比较相似, 需要剥离破坏一些解剖层次, 所以对组织破坏程度更大。

### 2.2. 单通道内视镜系统

单通道内视镜系统也叫经皮内窥镜(或全内窥镜)系统, 它是将工作通道内窥镜与工作通道及光学元件

放置在同一管状装置中, 需要盐水为介质, 进行持续的冲洗, 自从上世纪 80 年代, 就已经成为了标准的内窥镜脊柱手术[18] [19]。该技术在现代医学发展中已经得到广泛应用, 在操作上相对于显微内窥镜系统稍复杂。

### 2.3. 双通道内视镜系统

双通道内视镜系统即为双门内镜系统, 它具有两个单独的通道, 内窥镜通道和工作通道。内窥镜通道可以容纳单独的光学系统, 并且使用持续的盐水冲洗可获得优良的观察手术视野, 工作通道则可用于我们术者使用器械并进行手术操作的通道。相对于单通道内镜系统, 该系统操作较简单, 减压效果更明显, 但对正常组织的破坏也稍大。

## 3. 脊柱内镜系统在临床上的常见应用

不论是颈椎、胸椎还是腰椎, 就涉及脊柱内镜相关的疾病最主要还是: 椎间盘突出和椎管狭窄[20]。椎间盘突出或椎管狭窄会使硬膜囊或神经根受压变形, 解除这些外在因素的影响是内镜减压的首选。内镜减压最常见的应用是腰骶段, 其次是颈段及胸段。而根据疾病的特点我们可以采取经椎间孔入路、后入路、前路入路及腰骶尾部入路。

### 3.1. 脊柱内镜在颈椎疾病的常见技术应用

#### 3.1.1. 经前内镜颈椎间盘切除术(AECD)和经前内镜椎体入路减压术(AECTcD)

经前内镜颈椎间盘切除术是颈椎内镜手术的经典术式[21]。AO 脊柱的命名系统, 将此术式命名为 AECD (anterior endoscopic cervical discectomy) [22]。手术中患者采取仰卧位, 在局部麻醉或全身麻醉下, 术者采取经颈动脉鞘和气管之间安全空间入路将入路针在手术责任椎间隙插入, 之后用套管逐级扩张, 选择性的切除突出部位的椎间盘组织, 注意保留非突出部位的椎间盘组织, 当看到硬膜囊出现波动可确认减压成功[23]。Ahn [24]认为此术式的适应症: 1) 影像学上显示为软的椎间盘突出; 2) 症状与影像学位置符合; 3) 全身麻醉不耐受的脊髓型颈椎病; 4) 保守治疗达到 6 周仍无效。禁忌症: 1) 影像学显示为硬的椎间盘突出; 2) 出现明确的节段不稳; 3) 严重的脊髓型颈椎病; 4) 晚期颈椎病伴有椎间盘间隙狭窄; 5) 有神经或血管病变。经前内镜椎体入路减压术则是在十年前首次引出, 它有别于 AECD, 而是通过前路椎体的骨性通道进行选择性的椎间盘切除[25]。通过避开椎间隙通道, 我们就会保护到原有的椎间盘, 有利于患者术后的椎间隙高度的维持, 这对颈椎的稳定性十分重要[26]。AECTcD (anterior endoscopic cervical transcorporeal decompression)术中同样采取仰卧位, 在全麻下, 我们通常选择紧邻责任椎间盘下方的椎体, 在导航系统[27]的精准配合下将穿刺针插入, 使穿刺针尖端位于靠近椎体后方, 通过一系列扩张建立起椎体骨内通道, 在我们的内镜系统下摘除突出的椎间盘。Ren [28]对 35 名接受该术式的颈椎间盘突出症患者术后两年随访发现, 虽然该手术时间长但是椎间盘塌陷和复发率较低, 将骨性隧道的中心直径限制在 6 mm 时, 骨性缺损可以愈合而不会发生上终板塌陷, 可见此手术也可作为临床优选术式。

#### 3.1.2. 经后内镜椎间孔切开术和椎间盘切除术(PECFD)

PECFD (posterior endoscopic cervical foraminotomy and discectomy)作为颈椎病后路的经典减压手术[29], 相对于前路内镜手术, 它可以避免椎间隙塌陷[25]、气管、颈动脉及食管等椎间前方组织受损[30] [31], 而且曾有文献研究得出此术式具有一定的优势: 术后恢复时间缩短, 创伤小, 出血量更少[32]。患者术中采取俯卧位, 全麻或局麻方式, 定位后找到责任椎间盘所在的层面, 找到“V 点”后, 通过内窥镜椎间孔开窗, 显露并切除黄韧带找到突出的椎间盘组织, 将其摘除。Ahn [24]在大量的研究后认为此术

式的适应症有: 1) 影像学提示椎间盘在髓外侧边缘的外侧; 2) 一侧性神经根型颈椎病并伴有手臂疼痛; 3) 向头端或尾端的移位偏向外侧突出; 4) 椎间孔狭窄; 5) 保守治疗达 6 周仍无效。禁忌症有: 1) 有明确节段不稳; 2) 脊髓型颈椎病或中央管狭窄; 3) 中央或旁中央型突出; 4) 神经或血管病变。值得注意的是文献有一些术后相关并发症的报道, 特别是术后感觉迟钝这种特殊并发症, Zheng [33] 等认为预防术后感觉异常是切除术成功的最重要关键因素。Dominic [34] 等通过视频展示认为颈后路内镜手术过程快速, 耐受性好, 以后可考虑作为门诊患者术式, 并能达到快速恢复的要求。

### 3.2. 脊柱内镜在常见胸椎疾病的应用

过去胸椎疾病依赖于传统的开放手术, 相对于内镜下微创手术而言, 传统手术创面较大, 组织损伤剥离多, 增加术中失血量和对椎旁肌肉的创伤, 术后的不稳定性和诊疗时间也变得较多。像胸椎间盘突出症[35]、胸椎管狭窄[36]、黄韧带骨化[37]这些疾病在内镜下治疗也都有文献报道, 并且取得了不错的效果。Gao [38] 等对 11 名有症状的胸椎间盘突出患者进行了全内镜下椎间孔减压术, 术后患者的改良日本骨科协会(the modified Japanese Orthopedic Association, mJOA)评分从 7.4 上升到 10.2, 9 名患者有 8 名中轴胸痛得到改善, 所有患者的腿痛和胸神经根痛均得到了改善, 术后 MRI 显示脊髓减压良好。BoAn [39] 等对 18 例黄韧带骨化导致的胸椎脊髓病在局麻下进行全内镜下后路减压术治疗, 术后仅有两名患者出现了硬膜撕裂并发症, 术后随访 17.4 个月, ASIA 感觉和运动评分、mJOA 及 Frankel 评分均显著提高, 临床疗效满意。Yang [40] 等人对 2016 年 4 月至 2020 年 5 月连续介绍治疗的 20 例胸椎管狭窄术后随访中, 发现患者的手术时间、术后引流量、住院天数均较传统手术有较大改善。可见胸椎内镜下手术成为挑战脊柱疾病的另一种不错选择, 目前胸椎内镜下手术的研究报道处于起始阶段, 这需要我们继续以大样本、长期的临床研究提供更可信的循证医学证据。

### 3.3. 脊柱内镜在常见腰椎疾病的技术应用

腰椎疾病常见的术式主要有切除术和融合术两种。经皮内镜下腰椎间盘切除术(percutaneous endoscopic lumbar discectomy, PELD)主要包括经皮椎间孔入路腰椎间盘切除术(percutaneous endoscopic transforaminal discectomy, PETD)和经皮内镜下经椎板间入路髓核切除术(percutaneous endoscopic interlaminar lumbar discectomy, PEID)这两种经典术式。融合术主要介绍经皮内镜经椎间孔椎间融合术(endoscopic transforaminal lumbar interbody fusion, EndoTLIF)。

#### 3.3.1. 经皮椎间孔入路腰椎间盘切除术(PETD)

PETD (percutaneous endoscopic transforaminal discectomy)不仅在腰椎内镜手术中应用广泛并具有悠久的历史, 也是整个脊柱内镜手术中最具有代表性的经典内镜下手术[41]。手术可以在局麻下或清醒镇静下进行, 患者采取俯卧位, 术者在透视控制下经过一系列设计标记、确定皮肤切口、利用导丝、扩张器以及工作插管来引入内窥镜, 通过切除突出的椎间盘来逐步为神经减压。从经验上来看, 当我们切除的椎间盘组织量与 MRI 上看到的突出椎间盘相匹配或出现硬膜外间隙的波动, 可以被认为足够的减压[42]。PETD 技术最初适用于无钙化的腰间盘突出症, 现在已经适用于涉及复发型、迁移的、部分钙化的椎间盘突出症[14]。Li [43] 等人在对复发性腰椎间盘突出症对照实验的荟萃研究中认为, PETD 术后腿部疼痛(视觉模拟量表)的平均改善率为 66.92%、背痛(视觉模拟量表)的平均改善率为 54.91%、硬膜撕裂率为 0.1%、再手术率为 3.66%、并发症平均总体发生率仅为 4.89%, 这些数据表明要比开放式椎间盘切除术具有更好的结果。2016 年国内研究者[44]报道了 22 例 PETD 双通道治疗重度向上脱垂型腰椎间盘突出症的患者, 优良率达到 90%, 复发率仅为 4.5%。

### 3.3.2. 经皮内镜下经椎板间入路髓核切除术(PEID)

2008年, Ruetten [45]等人首次描述利用内镜进行PEID (percutaneous endoscopic interlaminar lumbar discectomy)技术。椎板间入路主要用于由于解剖学和技术等原因难以通过椎间孔入路充分进入椎间盘的情况, 并且L5-S1椎板间层面空间更宽广, 因此Ahn [24]、Chen [46]认为PELD是为L5-S1水平的腰椎间盘突出和高髂嵴而设计的。Ahn [24]总结该术式的适应症: 1) X线侧位片上, L5-S1水平髂嵴水平超过L5椎弓根中部; 2) 高度偏向头端或尾端的椎间盘突出 3) 对背侧或外侧椎间盘突出的程度没有限制; 4) 在头端和尾端椎板之间有足够的位置, 并且在下关节突的内侧边界到中线至少达到6 mm。PEID手术入路的特点具有组织水平清晰, 穿刺针穿过皮肤、浅筋膜、垂直脊肌后可到达黄韧带, 椎板间隙入口仅覆盖黄韧带, 无重要神经通过。所以PEID操作相对安全、简单, 但仍然有硬膜囊撕裂、脑脊液漏等术后并发症的报道[47]。值得我们注意的是, 为了保护脊柱的稳定性, 我们仍需减少对骨质、关节及韧带过多破坏。

### 3.3.3. 经皮内镜经椎间孔椎间融合术(EndoTLIF)

经椎间孔腰椎椎体间融合术(transforaminal lumbar interbody fusion, TLIF)被认为是一种标准的腰椎融合技术, 可以有效地对神经组织减压, 能同时达到避免神经损伤的效果[48]。近年来, EndoTLIF (endoscopic transforaminal lumbar interbody fusion)作为一项新兴的融合技术在微创融合手术中占有一席之地。患者取俯卧位, 在局麻、硬膜外麻醉或全身麻醉下, 通过透视寻找进针点: 上关节突(the superior articular process, SAP)的背侧, 结合侧位X线片可以确认。然后逐步用导丝、逐级扩张管置入, 将工作通道内窥镜推进到孔内, 内窥镜视野提供了对SAP表面和孔结构的充分观察。在使用双极射频去除软组织之后, 可以使用内窥镜毛刺、冲头和骨凿去除包括SAP在内的小关节。去骨应持续至黄韧带暴露, 操作直至黄韧带、椎间孔韧带和神经周围脂肪可以清晰地分辨出来。最后通过将椎间盘切除, 充分的终板准备, 放入尺寸相符的融合器。Yang [49]等对7例经EndoTLIF治疗的腰椎管狭窄患者12个月以上随访发现, 所有患者均达到椎间融合标准, 末次随访时, 根据改良的MacNab标准, 4例患者被评为优, 3例患者被评为良, 即使不能耐受全身麻醉的患者, 也获得满意的疗效。Zhang [50]等认为EndoTLIF技术在治疗腰椎退行性疾病时不仅可以实现双侧直接减压, 还可以减少正常解剖结构的损伤, 降低术后腰部疼痛等并发症, 值得注意的是手术过程需要X射线确定工作管, 患者和医生会暴露于更高剂量的辐射。

## 4. 对脊柱内镜未来的展望

内镜下脊柱微创手术的主流推动了当代脊柱医学的不断向前发展, 不论是内窥镜系统的研发还是改良术式的不断创新开展, 脊柱手术已经超越了过去很大一步, 相信不久的将来会突破更多难点, 内窥镜技术的优势会越来越凸显, 手术的明确指征会不断扩大, 大多数的退行性脊柱疾病都能在内镜下安全有效推广。最后, 外科技术的标准化和充分培训计划的实施可能会缩短学习曲线, 并增加该技术在日常临床实践中的相关性。

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