以纳米人工骨块充当间隔物在颈椎植骨后的融合*

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Nano-hydroxyapatite artificial bone serves as a spacer for fusion with the cervical spine after bone grafting

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文章亮点：

纳米人工骨块应用于颈后路双开门椎板扩大成形中，保留了颈椎的所有独立运动单元，骨块与棘突瓣适配性好，受压脊髓解压可靠，植骨融合满意，无骨块破裂和移位。

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Abstract

BACKGROUND: In recent years, allograft bone and coral bone have been commonly used as the spacers after double-door expansive laminoplasty, which can easily result in rejection and non-fusion.

OBJECTIVE: To verify the effect of nano-hydroxyapatite artificial bone on posterior double-door expansive laminoplasty in the cervical spine.

METHODS: Totally 46 patients undergoing posterior double-door expansive laminoplasty in the cervical spine received nano-hydroxyapatite artificial bone as the spacers. All patients were followed-up for over 3 months. Japanese Orthopaedic Association (JOA) scores before and after nano-hydroxyapatite artificial bone grafting were compared. The fusion of bone graft with the cervical spine was detected by X-ray and CT.

RESULTS AND CONCLUSION: At final follow up, JOA scores were increased from preoperative (7.9±1.9) points to (12.1±2.8) points. No patients were found cervical spine instability as well as loosening and displacement of the bone graft postoperatively. The fusion between the nano-hydroxyapatite artificial bone and spinous process was good. These findings suggest that the nano-hydroxyapatite artificial bone is an ideal bone graft substitute material and applicable to double-door expansive laminoplasty.

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摘要

背景：近年来椎板开门后多使用异体骨块和珊瑚人工骨等充当间隔物，结果易出现排异反应、不融合等情况。

目的：验证纳米人工骨块在颈椎后路双开门椎管成形中的应用效果。

方法：对46例行颈椎后路双开门椎管扩大成形的患者使用纳米人工骨块充当间隔物。随访3个月以上，比较纳米人工骨块置入前后日本骨科学会(JOA)评分，X射线和CT检测颈椎植骨融合状况。

结果与结论：随访病例于末次随访时日本骨科学会(JOA)评分由置入前(7.9±1.9)分提高至(12.1±2.8)，未见颈椎失稳和人工骨块松脱移位情况，纳米人工骨块和棘突融合良好。

关键词：纳米人工骨；双开门椎管扩大成形术；颈椎；日本骨科学会评分；棘突融合

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0 引言

颈椎后路双开门椎管扩大成形术是治疗颈椎病的重要方法之一[1-5]，以往椎板开门后大多取自体骨块充当间隔物，加重了患者的手术创伤，临床应用受到一定程度的限制[6-8]。近年来使用较多的异体骨块和珊瑚人工骨等充当间隔物，亦出现了排异反应、不融合等情况[9-11]。赣南医学院第一附属医院使用梯形纳米人工骨块充当颈椎后路双开门椎管扩大成形术间隔物，取得良好疗效。

1 对象和方法

设计：前后对照观察。

时间及地点：于2009-01/2011-09在赣南医学院第一附属医院完成。

对象：赣南医学院第一附属医院骨科收治的2008-0/2009-09患者46例，男31例，女15例。年龄25~78岁，平均52.3岁。发病至手术时间8~24个月，43例为多节段颈脊髓压迫，其中18例有急性外伤合并颈脊髓损伤四肢瘫痪；1例为颈椎管内良性肿瘤，广泛后纵韧带钙化2例，均经MRI检查确诊。共使用梯形纳米人工骨块220块。

诊断标准[12-16]：①缓慢出现肢体麻木、紧束感，手部动作笨拙，痉挛步态。②有一定的感觉障碍平面，上下肢肌张力升高，腱反射亢进，Hoffmann、BaLin—等病理征阳性。③X射线检查无特征性表现，可见病变椎间隙狭窄，椎体后缘骨质增生。CT检查可见椎体后缘骨刺形成、椎管矢状径变窄、后纵韧带骨化、黄韧带钙化及椎间盘突出。MRI显示脊髓前方呈弧形压迫，多节段病变可使脊髓受压呈波浪样压迹，严重者脊髓可变细，如合并后方压迫则脊髓呈串珠状。

纳入标准: ①有颈肩痛伴或不伴无明显诱因的躯体、四肢感觉、运动障碍，并且症逐渐加重者。②术前颈椎X射线和MRI提示颈椎生理曲度伴或不伴退行性改变如生理前曲变或消失，椎体退行性改变如椎体骨质增生、神经或脊髓受压，并且相应节段临床症状相符者。③经保守治疗无效者，在本科行颈后路减压植骨融合内固定并获得随访者。

排除标准：①合并严重脊柱畸形，陈旧性骨折和外伤性颈椎不稳者。②合并严重的器质性病变者。③行前路手术或前后联合入路手术者。

纳米人工骨块：上海瑞邦公司。

方法：

纳米人工骨块置入：气管插管全麻下取颈后正中切口，常规显露C_{3-7}椎板及棘突，截除部分过长棘突平C_3椎体棘突水平，用尖嘴咬骨钳咬除椎板根部外板骨皮质，构建两侧纵行门轴骨槽，用高速气动微型摆锯于棘突正中剖开颈椎棘突，向两侧掰开椎板，扩大椎管，清除粘连束带，用预制好的纳米人工骨块置入剖开棘突之间，用高强度尼龙线捆绑牢固，术野置管引流。本组共228开门节段，其中42例3~7开门，1例2~7开门，3例3~6开门，使用梯形纳米人工骨块220块(5例患者各1个节段采取自身咬除下来的棘突制作间隔体，3例因各有1节段棘突瓣断裂未用间隔物)，手术耗时80~150 min，平均100 min。术后颈托颈椎制动6~12周。

疗效评定：

神经功能评估及手术疗效评定：术前、术后采用日本骨科学会(JOA)评分了解脊髓功能状态，观察并发症的发生情况。

影像学评估：术后一两周MRI检查了解受压脊髓恢复情况；第3，6个月和末次随访时摄颈椎正侧位片和CT观察颈椎曲度、活动度和植块位置及愈合情况。

植骨融合标准：①完全融合：骨块与棘突接触面间无透明线，有连续骨质形成。②部分融合：透明线部分消失。③不融合：透明线清晰，未消失。

主要观察指标：①患者纳米人工骨块置入前后日本骨科学会(JOA)评分。②影像学检查结果。③植入材料的不良反应。

统计学分析：采用SPSS 17.0软件进行经t检验。

2 结果

2.1 *参与者数量分析* 纳入患者46例，按意向处理分析，全部进入结果分析。

2.2 *患者纳米人工骨块置入前后日本骨科学会(JOA)评分* 置入前平均(7.9±1.9)分，置入后平均(12.1±2.8)分，差异有显著性意义($P < 0.05$)。

2.3 *影像学检查结果* X射线和CT检查未见颈椎后凸畸形和颈椎节段性不稳定的发生，螺旋CT检查观察骨块与棘突融合情况，纳米人工骨块置入后6个月有5例30个节段，1年有8例41节段，2年有4例22节段。融合率分别为60%，85%和91%。所有骨块在位良好，未见骨块断裂、移位及再关门情况。 MRI检查显示椎管容积明显增加，颈脊髓漂移满意，脊髓压迹消失，见图1~4。

Figure 1 Preoperative, MRI showed severe multi-segment compression in the cervical spinal cord
图 1 患者术前 MRI 显示颈脊髓严重受压，多节段卡压

2.4 *植入材料的不良反应* 共使用220个人工骨间隔体，患者纳米人工骨块置入后无切口感染及排异反应，

无骨块破裂和移位。所有病例主观不适感均明显缓解，1例出现双上肢疼痛加重，对症治疗，半年后疼痛消失。

Figure 2 MRI showed a good drift, pressure trace disappeared in the spinal cord 2 wk after grafting
图 2 患者纳米人工骨块置入后 2 周 MRI 显示脊髓漂移好，压迹消失

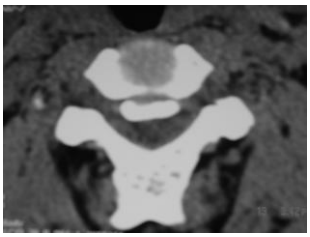

Figure 3 Severe calcification of the posterior longitudinal ligament and severe cervical spinal cord compression appeared preoperatively
图 3 患者手术前，后纵韧带严重钙化，颈脊髓严重受压

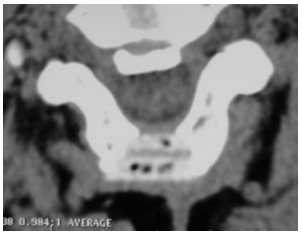

Figure 4 Bone healing appeared at 3 mon after grafting, spinal cord compression disappeared and the spinal cord recovered normal form
图 4 患者纳米人工骨块置入后 3 个月骨块愈合情况，脊髓压迫消失，已恢复正常形态

3 讨论

椎管成形术有单开门、双开门、双开门及中央植骨块撑开、Z形椎管成形术、椎板切除及棘突悬吊等多种术式。在颈椎椎管扩大成形术中以单开门、双开门、双开门及中央植骨块撑开为最常用术式。其中单开门术式中掀起的骨板由于椎板及棘突周围的韧带肌肉的张力作用，易出现向原位返纳的倾向，手术失败，甚至导致脊髓症状进一步加重情况出现[17-19]。双开门及中央植骨块撑开式则可以降低此种危险性[20-22]。

颈椎后路双开门椎管扩大成形术是治疗脊髓型颈椎病的常用方法，尤其适用于多节段颈椎管狭窄或脊髓压迫的患者，但因手术操作难度大，临床应用受到限制。作者通过改进操作技术，并使用已预制好的纳米人工骨块作为间隔体，显著简化了手术操作流程和缩短手术时间。该技术通过扩大颈椎管容积，使颈脊髓适度向后漂移，从而达到解除脊髓压迫的目的[23-25]。本组所有病例主观不适感均明显缓解，日本骨科学会评分术前平均分(7.9±1.9)，术后平均分(12.1±2.8)。研究结果提示脊髓功能恢复满意，未见脊髓损害加重的患者。

既往多采用自体髂骨、同种异体骨和羟基磷灰石作为棘突瓣间隔物，但取自体髂骨增加患者创伤，且需现场制作骨块，明显延长手术操作时间，增加手术风险；同种异体骨存在排异反应，增加感染风险。羟基磷灰石是最常见的一种生物活性材料，近年研究发现其可应用于临床骨缺损的治疗[26]。通过改进工艺技术目前已能制备出不同形状、孔隙率和降解率的商业化生产的羟基磷灰石人工骨。研究表明：羟基磷灰石具有良好的生物相容性，它们对宿主全身和局部无毒副作用，不引起炎性反应和异物反应，能与骨形成化学性结合，无纤维组织包膜将其和受区骨分开，不引起骨组织正常骨化过程的改变。但目前临床上所应用的羟基磷灰石人工骨仍存在力学性能差、脆性大、抗压抗折强度低等缺点[27]。有研究表明：当羟基磷灰石的尺寸达到纳米级时将表现出一系列独特的性能，纳米羟基磷灰石化学组成和结晶结构类似于人体骨骼中的磷灰石，具有良好的骨传导性能和生物活性，能与骨组织形成牢固的骨性结合促进骨骼生长，并且相态稳定，无毒性，是公认的性能良好的骨修复替代材料[28]。本组用纳米人工骨替代自体髂骨和同种异体骨进行颈椎后路植骨融合术，X射线和CT检查未见颈椎后凸畸形和颈椎节段性不稳定的发生，术后纳米人工骨与棘突间融合情况良好，术后3个月、1年、2年骨块与宿主骨的融合率分别达60%、85%和91%。即使未融合的骨块 ，与棘突瓣仍形成牢固的结构，未出现骨块移位、碎裂吸收及关门情况。 MRI检查显示椎管容积明显增加，颈脊髓漂移满意，脊髓压迹消失。取得了良好的临床效果。

综上所述，纳米人工骨块应用于颈后路双开门椎板扩大成形术，具有诸多优点。保留了颈椎的所有独立运动单元，骨块与棘突瓣适配性好，手术耗时少，出血少，受压脊髓解压可靠，疗效良好，植骨融合满意，无骨块破裂和移位，并发症较少，在颈椎椎管扩大成形术中具有良好的应用价值。

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