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在线全文

旋提手法对神经根型颈椎病患者颈部肌张力的效应分析*

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【摘要】 **目的** 通过剪切波弹性成像技术明确中医颈椎旋提手法治疗神经根型颈椎病的效应机制。**方法** 纳入神经根型颈椎病患者30例及30例近3个月内颈部无异常疾患的志愿者。对患者每周进行1次手法治疗，每次15～20 min，持续2周，患者全疗程进行3次治疗。对志愿者不进行任何治疗。以剪切波弹性成像技术为主要研究手段（主要结局指标为杨氏模量），探究旋提手法对神经根型颈椎病患者颈背部软组织的干预效应。在治疗前，首次手法治疗后及手法治疗两周后，对患者共进行3次剪切波弹性成像技术检测。志愿者全程进行1次剪切波弹性成像技术检测作为基线对照。次要结局指标为患者治疗前、治疗后及治疗两周后的视觉模拟评分（visual analogue scale, VAS）与颈椎功能障碍指数（neck disabilitv index, NDI）等临床疗效评价指标。**结果** 患者治疗前的颈部肌肉杨氏模量值高于志愿者（P<0.001），而在疗程结束后与志愿者相比差异无统计学意义；患者治疗前后及疗程结束前后肌群杨氏模量差异均有统计学意义（P<0.001）；患侧颈部肌群杨氏模量值高于健侧（P=0.001），而经治疗后两者间差异无统计学意义；杨氏模量中位数与神经根型颈椎病患者的VAS评分（r=0.741, P<0.001）、NDI评分（r=0.591, P<0.001）均存在正相关性。**结论** 旋提手法治疗能够降低神经根型颈椎病患者VAS评分与NDI评分，降低患者颈部肌肉张力，并能够在降低颈部肌群张力的同时平衡其分布；杨氏模量值是反映手法疗效的潜在指标。

【关键词】 中医正骨疗法 神经根型颈椎病 颈椎旋提手法 剪切波弹性成像

Effectiveness Analysis of Cervical Rotation-Traction Manipulation on Cervical and Dorsal Muscle Tone in Patients With Cervical Spondylotic Radiculopathy

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[**Abstract**] **Objective** To clarify the mechanism of action of the Cervical Rotation-Traction Manipulation in treating cervical spondylotic radiculopathy using shear wave elastography. **Methods** Thirty patients with cervical spondylotic radiculopathy and 30 volunteers without abnormal cervical conditions in the past three months were included. Patients received manipulation therapy once a week for 15 to 20 minutes, totaling three sessions over two weeks. Volunteers received no treatment. Shear wave elastography was the primary research method (with Young's modulus as the primary outcome measure) to assess the effect of the Cervical Rotation-Traction Manipulation on the neck and back soft tissues in patients with cervical spondylotic radiculopathy. Shear wave elastography was performed on patients three times: before treatment, after the first manipulation session, and after two weeks of treatment. Volunteers underwent one shear wave elastography test as a baseline control. Secondary outcome measures were the visual analogue scale (VAS) and

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neck disability index (NDI) scores of patients before treatment, after treatment, and two weeks after treatment. **Results** The Young's modulus values of the cervical muscles in patients before treatment were higher than those in volunteers (P < 0.001), but there was no statistically significant difference after the treatment course. There were statistically significant differences in the Young's modulus of the muscle before and after treatment and before and after the treatment course in patients (P < 0.001). The Young's modulus values of the affected side cervical muscles were higher than those of the healthy side (P = 0.001), but there was no statistically significant difference after treatment. The median Young's modulus was positively correlated with the VAS score (r = 0.741, P < 0.001) and the NDI score (r = 0.591, P < 0.001) in patients with cervical spondylotic radiculopathy. **Conclusion** The Cervical Rotation-Traction Manipulation can reduce the VAS and NDI scores of patients with cervical spondylotic radiculopathy, lower neck muscle tension, and balance the distribution of cervical muscle tension while reducing it. Young's modulus is a potential indicator reflecting the therapeutic effect of the spinal manipulation.

[Key words] Traditional Chinese spinal manipulative therapy Cervical spondylotic radiculopathy Cervical rotation-traction manipulation Shear wave elastography

颈痛(neck pain, NP)位列五大慢性疼痛之一[1],症状常迁延且易复发[2],是骨科临床常见的疼痛类型,其中约一半的慢性颈部疼痛患者表现为神经性-痛觉性混合症状或以神经性症状[3]。我国颈痛的发病率约为17.3%[4],以神经根型颈椎病(cervical spondylotic radiculopathy, CSR)最常见,约占所有颈椎病的60%~70%[5],其主要临床表现为颈部肌肉的疼痛不适与单侧或双侧上肢麻木、放射性疼痛、皮肤感觉敏感[6],通常会对患者的生活工作质量造成较大影响,保守治疗通常治疗该病的临床首选[7]。

中医手法是中医治疗神经根型颈椎病的常用手段。但目前针对中医手法治疗神经根型颈椎病的相关机制仍缺少高水平证据支持[8],在一定程度上阻碍了手法研究现代化进程及推广应用。颈部肌群内含许多压力、本体感受元件,而颈痛与肌肉张力亦存在相关性[9],通过定量化的肌张力测定有助于明确中医手法对神经根型颈椎病的干预效应。剪切波弹性成像技术(shear wave elastography, SWE)是一种非侵入性的超声成像技术,能够量化软组织的弹性模量并提供组织硬度定量信息[10-11]。为手法治疗提供数字化临床证据。基于此现状,在团队前期通过软组织张力云图技术解析中医手法治疗神经根型颈椎病效应机制[12]的工作基础上,本研究将纳入30例神经根型颈椎病患者与30例颈部无异常疾患的志愿者,通过剪切波弹性成像技术进一步明确中医手法的效应机制。

1 资料与方法

1.1 受试者

本研究经中国中医科学院望京医院医学伦理委员会审查批准,批准号WJEC-KT-2022-064-P002,批件有效期1年。本研究共纳入神经根型颈椎病患者与颈部无异常疾患志愿者各30例。纳入时间段为2024年1月15日–2024年6月1日,所有病例均来源于中国中医科学院望京医院及中国中医科学院骨伤科研究所门诊部处。通过张贴招募广告招募近3个月内无颈痛及上肢症状的志愿者。本研究为探索性研究,选用临床研究最小样本量[13],每组30例。患者/志愿者同意参与研究并签署知情同意书后,将患者的年龄、性别、神经放射痛患侧、病程(本次出现上肢麻木症状起)、是否患其他基础病、此前是否经过治疗、治疗手段等病史资料记录于记录册中。

1.2 分组

1.2.1 患者组

纳入标准:①纳入的患者应符合中国康复医学会于2010年颁布的《颈椎病诊治与康复指南》中神经根型颈椎病的诊断标准,并由两位主任医师明确诊断为神经根型颈椎病;②年龄:18~65岁;③患者病史资料有颈痛伴上肢放射性疼痛、单侧或双侧上肢麻木、皮肤感觉减退或敏感等神经根型颈椎病典型表现;④患者平片、CT等影像学诊断资料明确有“颈椎退行性病变”“椎间孔变窄”等描述。排除标准:①患有脊柱结核、骨髓炎等骨关节感染性疾病;②患有神经系统肿瘤;③基础疾病较多、需长期服用多种药物(如:严重心肺脑及血液病、肝肾功能不全等);④混合型颈椎病;⑤合并有严重骨质疏松症,不适宜行中医手法治疗;⑥合并发育性椎管狭窄(椎管矢状径/椎体矢状径<0.75);⑦患有肌少症、强直性脊柱炎、帕金森病;⑧上肢肌力≤3级;⑨治疗部位有严重皮肤病或皮损,无法接受手法治疗;⑩曾有颈椎手术史、不适宜行手法治疗;⑪孕期、哺乳期及经期妇女。终止标准:①手法治疗过程中患者出现头晕、冷汗、心跳加速等不适表现;②治疗过程中/剪切波检测过程中出现不适或明确要求停止研究者。

1.2.2 志愿者组

纳入标准:①年龄:18~65周岁;②近3个月无明显颈部不适症状;③颈椎平片、CT等影像学诊断资料明确无“颈椎退行性病变”“椎间孔变窄”;④由两位门诊医师确

定无颈部病变,可以进入研究。排除标准:①基础疾病较多、需长期服用多种药物(如:严重心肺脑及血液病、肝肾功能不全等);②合并发育性椎管狭窄(椎管矢状径/椎体矢状径< 0.75);③治疗部位有严重皮肤病或皮损,无法接受剪切波弹性成像检查;④患有强直性脊柱炎、帕金森病;⑤孕期、哺乳期及经期妇女。终止标准:剪切波检测过程中出现不适或研究过程中明确要求停止研究者。

1.3　干预方法

对患者组开展颈椎旋提手法(cervical rotation-traction manipulation, CRTM)治疗。该手法已形成了标准化操作流程,并形成了旋提手法教学机器人[14],保证术者手法操作的稳定性。该手法操作流程具体如下:患者坐位背对于术者,术者对患者颈背部肌群(主要为斜方肌及深层肌群)予以点法、滚法、揉法、拿法等放松类手法,操作约10 ~ 15 min,触诊明确无明显可触及筋节后,放松类手法结束。随后行扳动手法治疗:术者嘱患者颈部进行主动旋转、主动屈曲、主动再旋转,以上肢环抱患者头部,肘部托举患者下颌部,嘱患者放松颈部,并用肘部以轻快短促发力行纵向提拉扳动,留观5 min,在患者明确无头晕、颈部疼痛加重等不适后治疗结束。手法及触诊均由同一位主任医师完成。每周1次手法治疗,每次15 ~ 20 min,持续2周,患者全疗程进行3次治疗。

志愿者组不进行治疗性干预。

1.4　研究指标

1.4.1　主要结局指标

主要结局指标为杨氏模量。杨氏模量值越大,说明组织硬度越大。在治疗前,首次手法治疗后及手法治疗两周后共进行3次检测。志愿者全程进行1次检测作为基线对照。

本研究选择剪切波弹性成像技术,以每秒3 000 ~ 20 000帧的速度实时探测剪切波;采用彩色编码技术计算组织硬度指标杨氏模量值。研究检测设备为PHILIPS彩色超声诊断仪(荷兰PHILIPS公司生产制造),由中国中医科学院望京医院超声科提供。检测区域:本研究基于团队前期肌肉相关研究成果[12],针对颈部背侧的浅层肌群进行进一步分析:以棘突连线为中线分为左右两侧,将颈部肌肉分为8个检测区域,上颈段(C1 ~ C4)、下颈段(C5 ~ C7)、肩颈部及胸背段(T1 ~ T3),每侧各四个检测区域。见附图1。所有附图和附表见网络资源附件。

检测由同一位超声医师完成(副主任医师),术者一手操作探头,一手选择检测区域,并计算所选区域杨氏模量数值。术者将探头垂直于测量点皮肤处,以相同的挤压力将探头垂直压向患者颈部肌肉。选取测量区域,每一测量点测量三次,每次在图像中央、左侧、右侧三点测试,取平均值并记录。形成测试报告单,并交由第三方数据处理者保管。见附图2。

1.4.2　次要结局指标

另记录患者治疗前、治疗后及治疗两周后的视觉模拟评分(visual analogue scale, VAS)与颈椎功能障碍指数(neck disability index, NDI)等临床疗效评价指标作为次要结局指标。VAS评分范围0 ~ 10分,分数越高疼痛程度越高。NDI评分范围为0 ~ 50分,分数越高则患者颈部不适症状对其生活质量影响越大。

1.5　统计学方法

针对患者治疗前与志愿者差异分析用以评估神经根型颈椎病患者与颈部无异常疾患志愿者相关指标的差异,明确神经根型颈椎病的相关特征;患者治疗前后对比用以明确旋提手法的治疗效应。统计分析使用SPSS 20.0软件完成,分析前进行正态性检验,符合正态的数据采用$\bar{x} \pm s$的形式表示,两配对样本采用配对样本t检验,分布两独立样本采用独立样本t检验分析;不符合正态的数据采用中位数(P_{25}, P_{75})的形式表示。经检验,VAS、NDI评分、杨氏模量值不符合正态性分布,采用Friedman检验,通过Bonferroni法进行结果校正;患者患侧健侧杨氏模量值不符合正态分布,采用Mann-Whitney U检验分析;针对VAS、NDI评分与患者杨氏模量值的相关性,采用Spearman相关性分析。P< 0.05为差异有统计学意义。

2　结果

2.1　人群基本情况

30例患者中,左侧颈痛17例,右侧颈痛13例;病程(5.77±3.28)周。患者组年龄大于志愿者组(P= 0.002),其余基本资料差异无统计学意义。见表1。

表 1　受试者基本信息

Table 1　Basic information of participants

Index	CSR patients (n = 30)	Volunteers (n = 30)	t/χ^2	P
Age/yr., $\bar{x} \pm s$	39.50 ± 10.22	31.87 ± 6.04	3.520	0.002
(Male/female)/case	10/20	13/17	0.635	0.426
Height/cm, $\bar{x} \pm s$	166.23 ± 8.62	167.34 ± 8.26	0.493	0.851
Weight/kg, $\bar{x} \pm s$	62.33 ± 12.67	61.17 ± 15.05	0.325	0.747

CSR: cervical spondylotic radiculopathy.

2.2　主要结局指标

2.2.1　患者与志愿者的颈部肌群杨氏模量分析

经30名患者治疗前与志愿者的颈部肌群杨氏模量值差异具有统计学意义(P< 0.001),而疗程结束后两者差异无统计学意义(P= 0.671);患者治疗前后及疗程结束前后

肌群杨氏模量差异均有统计学意义(P< 0.001)(表2、附表1、附表2)。

表 2 患者与志愿者颈部肌群杨氏模量差异分析

Table 2 Analysis of differences in Young's modulus of neck muscles between patients and volunteers

Time	Young's modulus/kPa, median (P_{25}, P_{75})		U	P
	CSR patients (n = 30)	Volunteers (n = 30)		
Baseline	19.10 (17.05, 21.53)			
Before CRTM	32.25 (24.40, 40.15)		11.388	< 0.001#
After first CRTM	23.50 (18.40, 29.96)		8.519	< 0.001#
After all the treatment	18.72 (14.40, 23.96)		0.425	0.671#

CSR: cervical spondylotic radiculopathy; CRTM: cervical rotation-traction manipulation. # compared with volunteers at baseline.

2.2.2 患者患侧与健侧的杨氏模量分析

患者患侧与健侧治疗前后的肌群杨氏模量均有明显下降,且差异均具有统计学意义(P< 0.001);在治疗前,患侧颈部肌群杨氏模量值要显著高于健侧,其差异具有统计学意义(P= 0.001),而经治疗后两者间的差异则不有统计学意义(P= 0.245)(表3)。

表 3 30例患者患侧与健侧颈部肌群杨氏模量差异分析

Table 3 Analysis of the differences in Young's modulus of cervical muscle groups between the affected side and the healthy side in 30 patients

Time	Young's modulus/kPa, median (P_{25}, P_{75})		U	P
	Affected side (n = 30)	Healthy side (n = 30)		
Before CRTM	36.80 (26.80, 43.50)	29.40 (23.38, 36.08)	−3.417	0.001
After CRTM	25.10 (19.35, 30.80)	22.65 (17.90, 28.20)	−1.163	0.245
Z	−7.059	−5.247		
P	< 0.001	< 0.001		

CRTM: cervical rotation-traction manipulation.

2.2.3 颈痛与颈部肌群杨氏模量值的相关性分析

VAS评分与杨氏模量中位数成正相关(r= 0.741, P< 0.001);NDI评分与杨氏模量中位数成正相关(r= 0.591, P< 0.001)(图1)。

2.3 次要结局指标

患者治疗前后的VAS评分差异具有统计学意义(P< 0.001);首次手法治疗前后的VAS评分(P< 0.001)、首次治疗前与疗程结束后VAS评分(P< 0.001)及首次手法治疗后与疗程结束后的VAS评分(P= 0.009)的差异经Bonferroni法校正后仍具有统计学意义。NDI评分趋势与VAS评分类似(附表3、附表4、图2)。

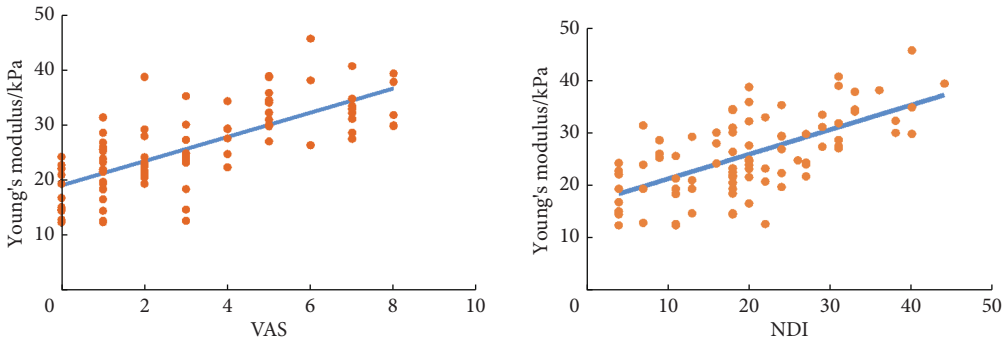

图 1 30例患者杨氏模量中位数与VAS/NDI的相关性

Fig 1 Correlation between the median Young's modulus of 30 patients and visual analogue scale (VAS) or neck disability index (NDI)

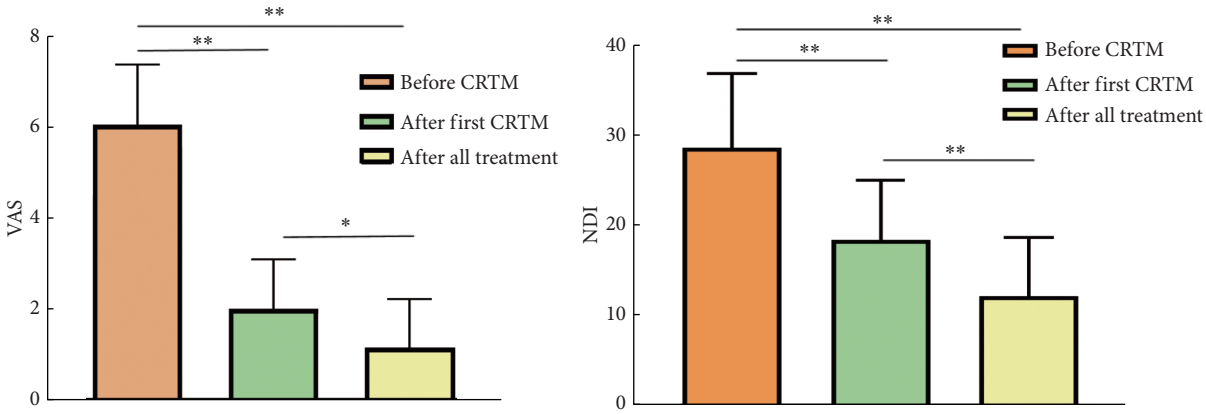

图 2 30例患者治疗前后VAS评分及NDI评分的变化

Fig 2 Changes in visual analogue scale (VAS) and neck disability index (NDI) scores before and after treatment in 30 patients

CRTM: cervical rotation-traction manipulation. * P < 0.05, ** P < 0.001.

3　讨论

神经根型颈椎病通常表现颈痛伴随为单侧或双侧的上肢麻木、放射性痛、皮肤感觉异常等症状，以单侧居多。颈痛是神经根型颈椎病的主要表现之一，通常与颈椎退变、本体感觉异常[15]等因素相关。已有许多研究提示颈腰部肌肉张力与疼痛存在一定的相关性[16-17]，这与许多物理治疗师、临床医师及颈痛患者的直观感受相同，但目前这一结论缺少高质量证据支持，存在一定的争议[18-19]。本研究通过剪切波弹性成像技术形成了手法治疗前后患者肌肉张力的量化指标，明确了颈椎旋提手法能够降低神经根型颈椎病患者颈背部双侧肌肉张力，并平衡双侧肌肉张力分布不均的现象，旨在为该领域提供一定的证据支撑。

3.1　肌肉紧张度与疼痛

骨骼肌是人体主要的感觉器官之一[20]，对感受及传导疼痛、振动、温度、本体感觉等均有重要作用[21]。肌肉中与疼痛传导相关的感受器主要包含两种，分别是位于肌腹中的肌梭(muscle spindle)[22]以及位于腱肌结合部位的高尔基腱器官(Golgi tendon organ)[23]。前者是特化的肌纤维，广泛存在于主要的骨骼肌中，主要作用是传导肌肉牵张的感觉信息与形成本体感觉，当肌梭敏感性增加时，肌肉张力会随之增强并引起肌肉收缩[24-25]，因此疼痛可能导致局部肌肉的紧张与肌张力增高；后者则是机体感受牵拉刺激的主要感受器，同时可传递肌肉活动引起的刺激。两者均对牵拉、压力、肌张力等刺激较为敏感，并联合调控肌肉张力的高低，这可能是肌张力与急慢性肌肉骨骼疼痛存在相关性的潜在机理[26]，也是通过脊椎手法治疗缓解肌肉骨骼疼痛的潜在效应机制之一[27]。

现阶段，虽然多数医师与康复师认为手法治疗具有放松肌肉、缓解疼痛的效应，但目前疼痛与肌张力的相关性仍存在争议，本研究将通过现有数据对患者的VAS评分、NDI评分与颈部肌群杨氏模量值进行相关性分析，明确了VAS评分及NDI评分与患者颈部肌群杨氏模量值呈现正相关，为颈痛与颈部肌张力的相关性提供新证据。

3.2　中医手法能够降低肌肉紧张度

“骨错缝，筋出槽”是中医骨伤科学对骨伤科疾病病因病机的主要概括，而“筋骨并重”“筋骨平衡”一直是中医骨伤科学的治疗理念。中医手法同样强调对软组织的治疗。手法治疗神经根型颈椎病的疗效明确，基于高肌张力与疼痛的潜在相关性，许多研究团队展开了探索，但仍缺乏高水平的循证证据：如通过探究不同操作频率、操作力度下滚法对肌肉组织的效应明确了手法具有放松肌肉、缓解疼痛的效应[28]；放松类手法能够显著降低患者颈背部的深层肌肉张力[29]；针对颈部无症状患者进行的肌张力分析提示手法不能放松颈部无症状患者的软组织张力，认为手法疗效可能只针对颈痛患者[30]。上述结论得到了一定范围内的认可[31-32]，但目前此类研究仍存在诸多问题：虽然杨氏模量值是反映肌张力的可靠数据，但该检测指标尚未在临床工作中普及，无参考值正常范围，只能依据患者症状及自身前后的对比进行数据分析。因此，该研究方法仍需进一步扩大样本量，并针对现存问题探索更多的客观化指标与研究手段。

本研究通过剪切波弹性成像技术证实：经过一疗程的手法治疗，患者颈部肌肉的张力明显下降，弹性明显升高。降低颈部肌肉张力，提升肌肉弹性，可能是旋提手法改善患者颈部疼痛及上肢症状的潜在机制；此外，经过旋提手法治疗后，神经根型颈椎病患者颈部两侧肌肉的杨氏模量值趋于平衡，颈椎旋提手法具有平衡健侧与患侧肌肉弹性的作用，提示无论患侧与健侧，旋提手法均能降低患者的颈部肌群张力，提高其弹性；同时，相较于颈部无疾患、无疼痛的志愿者，神经根型颈椎病患者的颈部肌肉张力、硬度明显更高，弹性更低；而治疗后该差异消失，提示手法治疗具有潜在的平衡双侧肌力分布不均的特征。

3.3　优势与不足

本研究在团队前期工作基础上，采用了可标准化评价的超声技术——剪切波弹性成像技术对颈椎旋提手法治疗神经根型颈椎病患者的颈部肌张力进行的数字化评估，明确了该手法能够降低患者的颈部肌张力并平衡患侧健侧的张力分布不均，为手法具有放松肌肉的效应机制提供了全新证据；同时，通过Spearman相关性分析明确了颈痛及功能障碍与颈部肌张力存在正相关性，为手法疗效判定提供了新的参考标准。

但本研究也存在一些不足：首先，本研究基于探索性实验的样本量估算原则，样本量相对较小，未能进一步提升研究结论的证据等级；其次，本研究患者的年龄较为分散，且中年女性患者占比较多，但由于患者数量较少，未进行细致的分层研究，影响了结论的细致性；另外，研究疗程相对较短，重点明确了手法治疗的即刻疗效，但对于手法的中远期疗效未能进行追踪研究与记录；同时，如果能对患者的颈部肌张力进行长期检测，有可能得出颈部肌群杨氏模量的可靠正常参考值范围，有助于后续神经根型颈椎病患者发病的预测与疗效评估。

在后续的研究工作中，团队将在本研究的基础上扩大样本量和研究时长，重点针对手法治疗神经根型颈椎病的远期效应进行追踪，进一步明确颈椎旋提手法的效应机制。

* * *

作者贡献声明 王旭负责论文构思、数据审编、正式分析、调查研究、研究方法和初稿写作,冯天笑、孙凯、刘宁和谢榕负责调查研究,朱永涛和赵小琪负责提供资源、软件和可视化,朱立国负责经费获取、研究项目管理、监督指导和审读与编辑写作,刘广会负责研究项目管理、提供资源、监督指导和审读与编辑写作,魏戌负责论文构思、经费获取、研究项目管理、监督指导和审读与编辑写作。所有作者已经同意将文章提交给本刊,且对将要发表的版本进行最终定稿,并同意对工作的所有方面负责。

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