临床论著

不同类型颈椎病患者颈伸肌肌容量与颈椎矢状位参数的差异及相关性研究

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【摘要】目的:探讨不同类型颈椎病患者之间颈伸肌肌容量与颈椎矢状位序列的差异及相关性。**方法**:回顾性分析 2016 年 5 月~2018 年 7 月就诊于北京大学国际医院的颈椎病患者 563 例,其中男性 304 例,女性 259 例,平均年龄 53.3±19.6 岁,根据颈椎病的类型分为 A 组(脊髓型颈椎病,n=208)、B 组(神经根型颈椎病,n=194)和 C 组(颈型颈椎病,以轴性症状为主且无神经受压的临床症状或体征,n=161)。所有患者行颈椎 MRI 及颈椎侧位 X 线片检查。通过 PACS (picture archiving and communication systems)系统在颈椎侧位 X 线片上测量颈椎矢状位参数序列:C2-7 Cobb 角、C0-2 Cobb 角、C7 斜率 (C7 slope,C7S) 和 C2-7 矢状垂直轴 (C2-7 sagittal vertical axis,C2-7 SVA)。通过 Image J 软件对 MRI 轴位像上 C3~7 上终板水平浅层颈伸肌截面积(superficial extensor area,SEA)、深层颈伸肌截面积(deep extensor area,DEA)与相应颈椎椎体截面积(vertebra body area,VBA)的比值进行了测量和分析,以 SEA/VBA 及 DEA/VBA 作为颈伸肌肌容量。采用 ANOVA 单因素方差分析对组间矢状位参数,颈伸肌肌容量进行对比(组间两两对比采用 Games-Howell 法),采用 Pearson 相关性分析对颈伸肌肌容量与矢状位参数关联性进行分析。**结果**:C2-7 Cobb 角 A 组(8.64°±6.19°)显著低于 B 组(12.55°±6.27°,P<0.05)及 C 组(13.08°±5.77°,P<0.05);C7S A 组(28.09°±10.16°)显著高于 B 组(22.26°±7.55°,P<0.05)及 C 组(21.63°±8.96°,P<0.01);C2-7 SVA A 组(21.77±12.38mm)显著高于 B 组(17.80±10.82mm,P<0.05)及 C 组(15.54±6.82mm,P<0.01)。SEA/DEA 比值各组之间无显著统计学差异,A 组患者 DEA/VBA 比值明显低于 B、C 组(P<0.05),其中以 C3-5 水平差异最为显著(P<0.05)。Pearson 相关分析显示 A 组 C3 DEA/VBA 比值与 C2-7 SVA(r=-0.379,P<0.05)及 C7S(r=-0.311,P<0.05)呈弱负相关,C4 水平 DEA/VBA 比值与 C2-7 SVA(r=-0.478,P<0.01)及 C7S(r=-0.466,P<0.01)呈中度负相关,而 SEA/VBA 比值与矢状位参数未表现出显著统计学相关性。**结论**:脊髓型颈椎病患者的颈椎矢状位序列较其他类型颈椎病表现出显著的失平衡改变,脊髓型颈椎病患者的深层颈伸肌体积显著低于其他类型的颈椎病,深层颈伸肌近头端附着区域的体积与 C2-7 SVA 及 C7S 之间存在一定程度的负相关性。

【关键词】 颈椎病;颈伸肌肌容量;颈椎矢状位序列
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【Abstract】Objectives: To explore the relationship between the volume of cervical extensor and the sagittal alignment position in patients with different types of cervical degenerative diseases. **Methods:** Retrospective analysis was performed on patients with cervical degenerative diseases who were treated in Peking University International Hospital from May 2016 to July 2018. 563 patients(female/male 259/304, average age 53.3±19.6 years) were divided into group A(cervical spondylotic myelopathy, n=208), group B(cervical spondylotic radiculopathy, n=194) and group C(cervical degenerative disease without neurological symptoms, n=161). C2-7cobb angle and C0-2 Cobb angle, C7 slope(C7S) and C2-7 sagittal vertical axis(C2-7 SVA) were measured and recorded using picture archiving and communication systems (PACS). The ratios of superficial extensor area (SEA), deep extensor area(DEA) and vertebra body area(VBA) of C3-7 upper endplate were measured and

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analyzed by Image J software. The volume of cervical extensor was quantified by SEA/VBA and DEA/VBA. Single-way ANOVA analysis of variance was used to compare the data of each group, and Pearson correlation analysis was used to analyze the possible correlation between the volume of cervical extensor and sagittal parameters. **Results:** C2-7 Cobb angle of group A(8.64°±6.19°) was significantly lower than that of group B (12.55°±6.27°) and group C(13.08°±5.77°, P<0.05). C7S of group A(28.09°±10.16°) were significantly higher than those of group B(22.26°±7.55°, P<0.05) and group C(21.63°±8.96°, P<0.01). C2-7 SVA of group A (21.77±12.38mm) were significantly higher than those of group B(17.80±10.82mm, P<0.05) and group C(15.54±6.82mm, P<0.01). There was no significant difference in SEA/DEA ratio among all three groups. The DEA/VBA ratio in group A was significantly lower than that in group B and C (P<0.05), among which C3-5 was the most significant levels(P<0.05). In group A, C3 DEA/VBA ratio was weakly negatively correlated with C2-7 SVA(r=-0.379, P<0.05) and C7S(r=-0.311, P<0.05), while C4 DEA/VBA ratio was moderately negatively correlated with C2-7 SVA (r=-0.478, P<0.01) and C7S (r=-0.466, P<0.01), while SEA/VBA ratio was not significantly negatively correlated with sagittal parameters. **Conclusions:** Cervical sagittal malalignment in patients with cervical spondylotic myelopathy is more significant than that in other types of cervical degenerative diseases. The volume of deep extensors in patients with cervical spondylotic myelopathy is significantly lower than that in other types of cervical degenerative diseases. The volume reduction of the proximal attachment area of deep extensors is significantly correlated with the disorder of sagittal alignment of cervical spine.

【Key words】 Cervical spondylotic; Cervical extensor; Cervical sagittal alignment

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颈椎的矢状位平衡是指自然站立状态下，维持合理头部重心位置的颈椎序列。颈椎矢状位序列紊乱是颈椎病患者常见的影像学表现[1,2]。Panjabi 等研究[3]发现，维持颈椎序列稳定的 80% 的机械力来自颈椎肌肉，而剩下的 20%则是由颈椎韧带结构负担。颈后方浅层伸肌主要由头夹肌，颈夹肌，头半棘肌构成，而颈后深层伸肌主要由颈半棘肌、多裂肌、回旋肌和棘间肌组成[4~6]，颈伸肌为颈椎活动提供动力，同时对颈椎的静态和动态稳定性有很大影响[7~9]。目前关于颈伸肌对颈椎矢状位序列的影响研究甚少，颈椎退变性疾病患者的颈伸肌肌容量、颈椎矢状位序列之间的关系尚不清楚。因此，本研究对不同临床表现的颈椎病患者的颈伸肌肌容量进行量化研究，并对不同类型颈椎病患者的颈伸肌肌容量、矢状位参数之间的差异及两者之间的相关性进行统计学分析。

1 资料和方法

1.1 一般资料

回顾性分析 2016 年 5 月~2018 年 7 月我院收治的颈椎病患者的临床资料。纳入标准：(1)影像学证实存在颈椎退行性改变；(2)患者存在颈部轴向疼痛或者颈椎神经(脊髓或神经根)受压的临床表现。排除标准：(1)肿瘤史；(2)颈椎手术史；(3)颈椎外伤史；(4)先天性颈椎发育畸形；(5)寰枢椎不稳。

共纳入 563 例患者，年龄 57.9±28.3(33~76)岁，其中男性 304 例，女性 259 例。根据临床表现和影像学资料，按照患者影像学及临床表现分为 ABC 三组，A 组为脊髓型颈椎病(男性 112 例，女性 96 例，年龄 55.6±21.8 岁)，B 组为神经根型颈椎病（男性 107 例，女性 87 例，年龄 49.9±17.3 岁)，C 组颈型颈椎病，以轴性症状为主且无神经受压的临床症状或体征(男性 85 例，女性 76 例，年龄 54.3±25.9 岁)

1.2 颈椎矢状面参数测量

采用 PACS（picture archiving and communication system）系统对患者颈椎侧位 X 线片进行测量。测量并记录所有患者的 C2-7 Cobb 角、C0-2 Cobb 角、C7 斜率(C7 slope，C7S)和 C2-7 矢状垂直轴（C2-7 sagittal vertical axis，C2-7 SVA）(图 1)。由于 T1 椎体在部分患者 X 线上显影欠清晰，为减少误差，本研究未将 T1 倾斜角纳入研究。

1.3 肌肉测量

PACS 系统中同时打开 MRI 矢状位及轴位像，锁定正中矢状位 MRI 图像，然后截取平行于 MRI 正中矢状位图像上 C3~7 椎体上终板水平的

轴位 MRI 图像作为最终测量图像(由于寰枢椎区域为枕下肌群的附着点，肌肉横截面积的测量误差较大，因此没有将 C1-2 水平的数据纳入研究)。利用 IMAGE J 1.8.0 软件(National Institutes of Health,USA)对颈椎椎体和伸肌的边界进行了描绘界定(图 2)。用同一软件分析浅层颈伸肌截面积(superficial extensor area,SEA)、深层颈伸肌截面积(deep extensor area,DEA)与相应颈椎椎体截面积(vertebra body area,VBA)并计算其比值(SEA/VBA、DEA/VBA)。借鉴了以往文献[10,11]的伸肌体积测量办法，我们使用 SEA/VBA 及 DEA/VBA 比率来量化颈伸肌的体积,以规避由于患者的体型差异带来的测量偏倚。为减少误差,由 2 位作者分别测量 2 次后取平均值。

1.4 统计分析

Kolmogorov-Smirnov 检验以及 Levene′s 检验提示我们的数据符合正态分布。采用 ANOVA 单因素方差检验分析组间矢状面参数、SEA/VBA 比值及 DEA/VBA 比值的差异(采用 Games-Howell 法进行组间两两对比)。用 Pearson 相关系数分析颈伸肌肌容量(SEA/VBA、DEA/VBA)与颈椎矢状位参数之间的相关性。所有数据均采用 SPSS 24.0 进行统计分析。$P<0.05$ 有统计学意义。

2 结果

2.1 颈椎矢状面参数对比

ANOVA 方差分析显示,A 组 C2-7 SVA 显著高于 B 组($P<0.05$)和 C 组($P<0.01$),而 A 组 C2-7 Cobb 角及 C7S 显著低于 B 组和 C 组($P<0.05$),B 组的 C2-7 SVA 显著高于 C 组($P<0.05$)。三组间 C0-2 Cobb 角无显著性差异(表 1)。

2.2 颈伸肌肌容量对比

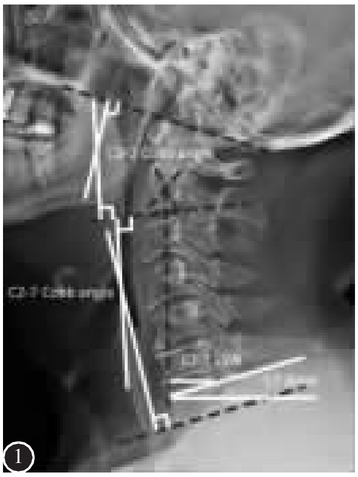
SEA/DEA 比值各组之间无显著统计学差异，A 组患者 DEA/VBA 比值明低于 B、C 组($P<0.05$),其中以 C3、C4、C5 水平差异最为显著($P<0.05$,表 2)。

2.3 颈伸肌肌容量与矢状面参数的相关性

Pearson 相关系数(r)设定:小于 0.2 为极弱或无相关,0.2~0.4 为弱相关,0.4~0.6 为中度相关,大于 0.6 为强相关。Pearson 相关分析显示,A 组 C3 水平 DEA/VBA 比值与 C2-7 SVA($r=-0.379$, $P<0.05$)和 C7S($r=-0.311$,$P<0.01$)呈弱负相关,C4 水平 DEA/VBA 比值与 C2-7 SVA($r=-0.478$,$P<0.01$)和 C7S($r=-0.466$,$P<0.01$)呈中度负相关,而 A 组 C2-7 Cobb 角与 DEA/VBA 比值呈极弱或无相关。B、C 组颈椎矢状面参数与 DEA/VBA 比值呈无或极弱相关。SEA/VBA 比值与颈椎矢状位参数呈无或极弱相关(表 3)。典型病例见图 3、4。

3 讨论

既往文献已证实，颈椎肌肉的病理改变与颈椎的退行性病变的发生发展有关。Tamai 等[10]的研



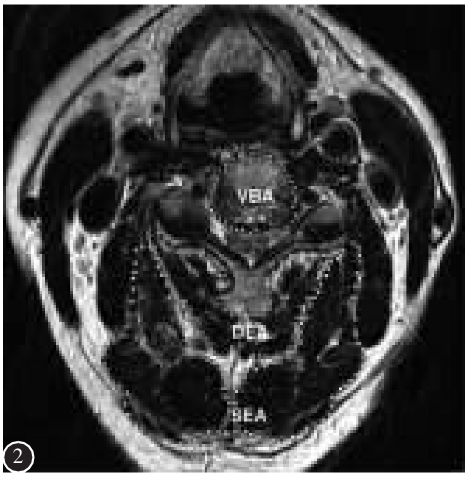


图 1 颈椎矢状位参数图示。C0-2 Cobb 角:McGregor 线(硬腭后缘至枕骨鳞部最低点的连线)与 C2 下终板平行线之间的夹角;C2-7 Cobb 角:C2 下终板平行线与 C2 下终板平行线之间的夹角;C7S:水平参考线与 C7 上终板的平行线之间的角度;C2-7 SVA:经过 C2 中心的垂线与 C7 椎体后上角之间的水平距离 **图 2** VBA:椎体横截面积;DEA:深伸肌横截面积;SEA:浅伸肌横截面积

Figure 1 Schematic drawing of cervical parameters. C0-2 Cobb angle: the angle between Mc′Gregor line (the line from the posterior margin of the hard palate to the lowest point of the occipital squama) and the line through the lower endplate of C2; C2-7 Cobb angle: the angle between the line through the lower endplate of C2 and the line through the lower endplate of C7; C2-7 SVA: the horizontal distance between the vertical line through the center of C2 and the posterior superior point of C7 **Figure 2** VBA: cross-sectional area of vertebral body; DEA: cross-sectional area of deep extensors; SEA, cross-sectional area of superficial extensors

表 1 各组颈椎矢状位参数及组间单因素 ANOVA 分析

Figure 1 One-way ANOVA analysis of cervical sagittal parameters between groups

	A组 Group A	B组 Group B	C组 Group C	*F*值 *F* value
C2-7 垂直矢状轴(mm) C2-7 SVA	21.77±12.38	17.80±10.82①	15.54±6.82①	85.29②
C0-2 Cobb 角(°) C0-2 Cobb angle	12.15±6.28	11.50±6.43	13.11±4.04	3.83
C2-7 Cobb 角(°) C0-2 Cobb angle	8.64±6.19	12.55±6.27①	13.08±5.77①	16.94②
C7 斜率(°) C7 Slope	28.09±10.16	22.26±7.55①	21.63±8.96①	15.97②

注:①与 A 组相比 *P*<0.05;②ANOVA 单因素分析提示存在三组数据分布 *P*<0.05

Note: ①Compared with Group A, *P*<0.05; ②One-way ANOVA analysis indicated statistical differences of data distribution between groups, *P*<0.05

表 2 颈伸肌肌容量组间单因素 ANOVA 分析

Figure 2 One-way ANOVA analysis of cervical extensors between groups

	DEA/VBA 比值 DEA/VBA Ratio					SEA/VBA 比值 SEA/VBA Ratio				
	C3	C4	C5	C6	C7	C3	C4	C5	C6	C7
A组 Group A	0.83±0.37	1.26±0.47	1.55±0.52	2.37±0.71	1.81±0.51	3.95±0.88	4.33±0.46	4.41±0.53	5.46±0.79	4.83±0.66
B组 Group B	1.22±0.34①	1.80±0.46①	2.42±0.54①	2.48±0.60	1.74±0.49	4.27±0.93	4.43±0.60	4.56±0.52	5.51±0.53	4.72±0.50
C组 Group C	1.31±0.40①	1.91±0.64①	2.56±0.71①	2.51±0.63	1.87±0.55	4.15±0.60	4.45±0.72	4.86±0.93	5.48±0.60	4.78±0.48
*F*值 *F* value	78.48②	106.98②	53.03②	2.61	21.62②	20.91②	13.47	8.48②	11.02	4.01

注:采用 Games-Howell 法进行事后两两对比;①与 A 组相比 *P*<0.05;②ANOVA 单因素分析提示存在三组数据分布具备组间统计学差异 *P*<0.05

Note: Games Howell method is used to make a comparison between groups; ①Compared with group A, *P*<0.05; ②One-way ANOVA analysis indicated statistical differences of data distribution between groups, *P*<0.05

表 3 颈椎矢状位参数与 DEA/VBA 比值及 SEA/VBA 比值的 Pearson 相关性分析

Table 3 Pearson correlation of the cervical sagittal parameters and DEA/VBA ratio and SEA/VBA Ratio between groups

		DEA/VBA 比值相关系数 Correlation coefficient of DEA/VBA ratio					SEA/VBA 比值相关系数 Correlation coefficient of SEA/VBA ratio				
		C3	C4	C5	C6	C7	C3	C4	C5	C6	C7
A组 Group A	C2-7 SVA	-0.379^{*b}	-0.478^{**a}	-0.173^{**c}	-0.09	-0.006^{*c}	-0.213	-0.106	0.050^{*c}	-0.101^{*c}	0.235
	C0-2 Cobb	-0.136	-0.037	-0.039	0.053^{*c}	-0.232	0.144	-0.129	0.331	-0.132	0.187
	C2-7 Cobb	-0.098^{*c}	-0.243	-0.085	0.144	-0.066	-0.007^{*c}	-0.013	0.376	0.119	0.054
	C7S	-0.311^{**b}	-0.466^{**a}	-0.123	-0.085^{*c}	-0.115	-0.146	-0.087	-0.182	-0.115^{*c}	0.301
B组 Group B	C2-7 SVA	-0.338	-0.161	0.13	-0.072^{*c}	0.202	0.261	0.107	-0.073	0.2	-0.501
	C0-2 Cobb	0.129	0.056^{*c}	0.142^{*c}	0.019	0.141	0.055	0.145	-0.189^{*c}	0.107	-0.173
	C2-7 Cobb	0.225	-0.003	0.214	-0.031	0.052	-0.009	0.112	-0.076	0.133	-0.098
	C7S	-0.109^{*c}	0.026	0.021	-0.022	0.079	0.025	0.034	-0.028^{**c}	0.079	-0.066
C组 Group C	C2-7SVA	-0.406	-0.055	0.021	0.138^{**c}	-0.028	-0.083	0.004	-0.168	-0.095	0.082
	C0-2 Cobb	-0.089	0.075	0.037	-0.102	0.026	0.073	0.139	-0.003	0.046	-0.398
	C2-7 Cobb	0.231	-0.032	0.006^{*c}	-0.096	0.007	-0.032	0.226	-0.096^{*c}	0.027	0.401
	C7S	0.188	0.101	0.039	-0.025	-0.093	0.241	-0.231	-0.115	-0.028	-0.173

注:VBA,椎体横截面积;DEA,深伸肌横截面积;SEA,浅伸肌横截面积;***P*<0.01,* *P*<0.05;a 具有统计学意义的中等程度相关;b 具有统计学意义的弱相关;c 具有统计学意义但 Pearson 相关性呈无或极弱相关

Note: VBA, vertebral body area; DEA, of deep extensors area; SEA, superficial extensors area; ***P*<0.01, **P*<0.05; a, Moderate correlation with statistical significance; b, Weak correlation with statistical significance; c, Although with statistical significance, no or very weak pearson correlation

究提示颈椎肌肉退行性改变可能是颈椎退行性滑脱的原因之一。Michele 等[12]发现颈椎肌力下降是颈椎间盘退变最重要的危险因素。颈椎伸肌是颈椎的重要动力系统及稳定系统，已有研究证实保留颈半棘肌附着点对于减轻颈椎后路单开门椎管扩大成形术术后颈椎轴性症状以及维持颈椎正常矢状位序列具有重要意义[13,14]。

颈椎伸肌萎缩现象在颈椎病患者中常见，以往对脊髓型颈椎病的研究发现，颈椎椎旁伸肌容积与颈椎管直径呈正相关，这提示颈椎管狭窄与颈椎伸肌萎缩有关[15,16]。本研究表明脊髓型颈椎病患者的深伸肌体积(DEA/VBA 比值)明显低于神经根型颈椎病及颈型颈椎病的患者。这表明颈脊髓受压可能是导致颈深伸肌萎缩的一个因素，与以前文献[15,16]报道的研究结果一致；但各组之间的 SEA/VBA 比值无统计学差异，这提示脊髓型颈椎病患者相对于其他类型的颈椎病并没有产生更为严重的浅层颈椎伸肌萎缩。我们认为这种现象可能与颈椎伸肌的神经支配有关，深层伸肌的神经支配主要来源于脊神经后支，脊髓受压抑制了脊神经后支对深伸肌的神经营养作用，而浅层伸肌的神经支配存在肩胛背神经及枕大神经的参与[5,6]，因此深层伸肌萎缩更为显著。

有文献报道了腰椎椎旁肌萎缩与腰椎矢状位序列的相关性[17~20]，Pezolato 等[21]发现腰椎生理曲度变浅的患者表现出更为严重的竖脊肌和多裂肌萎缩；Lee 等[22]研究证实了退行性腰椎后凸患者椎旁肌脂肪浸润较腰椎曲度正常的患者更为明显；Jun 等[23]对腰椎椎旁肌对脊柱整体矢状面平衡的影响进行了研究，指出腰椎椎旁肌萎缩是影响脊柱整体矢状面平衡的重要因素之一，并首次提出以 MRI 横断面图像上腰椎椎旁肌横截面积与相应节段椎体横截面积的比值来量化腰椎椎旁肌的体积。这些研究表明，椎旁肌在维持脊柱正常的矢状序列中起着重要作用。

而颈椎病患者的颈椎伸肌脂肪浸润情况及形态计量学数据的研究[24,25]，认为颈椎病患者伸肌萎缩对颈椎的功能状态存在负面影响。

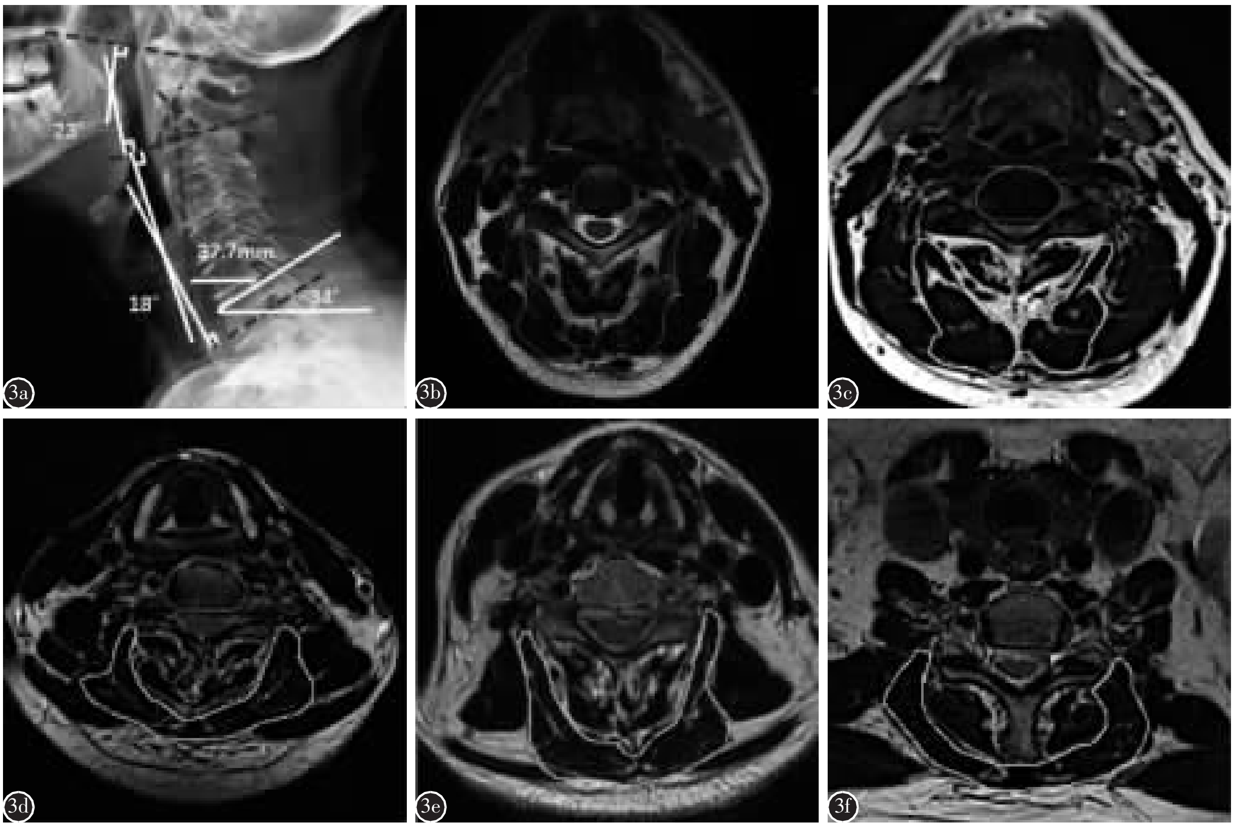


图 3 CSM 患者，男性，60 岁，矢状面序列不齐 **a** C2-7 SVA 8.9mm，C7S 21°，C2-7 Cobb 角 28°，C0-2 Cobb 角 6° **b~f** C3-7 DEA/VBA 比值分别为 2.27、1.93、2.05、2.43、1.39，SEA/VBA 比值分别为 2.87、2.02、3.13、2.98、2.92

Figure 3 In a patient diagnosed as CSM(60, male) with cervical sagittal malalignment **a** C2-7 SVA 8.9mm, C7S 21°, C2-7 Cobb angle 28°, C0-2 Cobb angle 6° **b-f** DEA/VBA ratio of C3-C7(2.27, 1.93, 2.05, 2.43, 1.39), SEA/VBA ratio of C3-7(2.87, 2.02, 3.13, 2.98, 2.92)

本研究显示,A 组（脊髓型颈椎病）的 C2-7 SVA 和 C7S 显著高于 B 组（神经根型颈椎病）和 C 组(颈型颈椎病),而 A 组的 C2-7 Cobb 角显著低于 B 组和 C 组;而 Pearson 相关性分析显示 BC 两组的深层伸肌容积(DEA/VBA)以及 ABC 三组浅层伸肌的容积(SEA/VBA)均未与颈椎矢状位参数并表现出统计学关联性，但 A 组的 DEA/VBA 比值与 C2-7 SVA 和 C7S 呈显著负相关，尤以 C3、C4 水平相关性最为显著。由此可知,脊髓型颈椎病患者的颈椎矢状面序列较无神经症状的神经根型颈椎病和退行性颈椎病患者表现出明显的失平衡改变,主要表现为颈椎重心前移(C2-7 SVA 增大),下颈椎曲度变直或后凸(C2-7 Cobb 角减小)以及颈胸段脊柱过屈(C7S 增大);而脊髓型颈椎病患者的 C2-7 SVA 及 C7S 值越大,深伸肌体积萎缩越明显，并且深伸肌的体积萎缩主要存在于深伸肌的颈椎近头端附着区域（C3、C4 为深伸肌在颈椎近头端的附着止点）,这说明,脊髓型颈椎病患者的颈椎重心前移(C2-7 SVA 增大)与颈胸段脊柱过屈(C7S 增大)与深伸肌近头端附着区域的体积萎缩存在关联性。

本研究的局限性在于:首先,样本量有限,无法根据脊髓压迫程度和椎管狭窄程度对脊髓型颈椎病患者进行详细的分组和统计，因此脊髓压迫与伸肌萎缩程度之间的详细关联性无法进行分析。其次,我们只讨论了颈椎矢状参数与颈伸肌体积的关系,没有分析脊柱整体的矢状平衡。再次，本研究仅限于颈椎退变人群，缺乏正常成人颈椎矢状面参数和椎旁肌体积的数据。

4 结论

相比于其他类型颈椎病，脊髓型颈椎病患者存在显著的下颈椎曲度变直或后凸（C2-7 Cobb 角减小),颈椎重心前移(C2-7 SVA 增大),颈胸段脊柱过屈(C7S 增大)以及深伸肌体积缩减,而不同类型颈椎病的浅层伸肌容积没有明显差异；同时，脊髓型颈椎病患者深伸肌近头端附着区的体积萎缩与颈椎重心前移(C2-7 SVA 增大)及颈

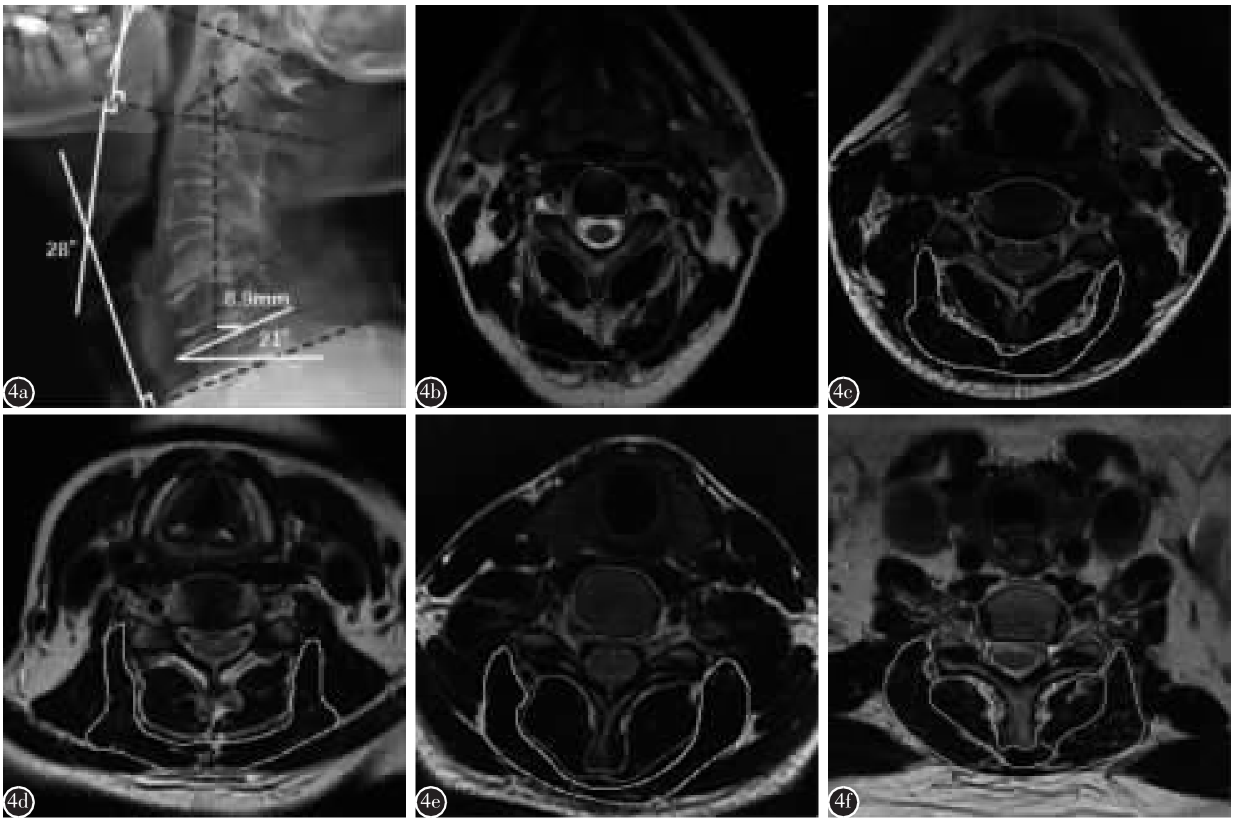


图 4 CSM 患者,男性,60 岁,颈椎矢状面序列正常 **a** C2-7 SVA 37.7mm,C7S 34°、C2-7Cobb 角 18°,C0-2 Cobb 角 23° **b~f** C3-7 DEA/VBA 比值分别为 1.33、0.98、2.21、1.84、1.48；SEA/VBA 比值分别为 3.23、2.80、3.24、2.49、2.31

Figure 4 In a patient diagnosed as CSM (57, male) with normal cervical sagittal balance **a** C2-7 SVA 37.7mm, C7S 34°, C2-7 Cobb angle 18°, C0-2 Cobb angle 23°, DEA/VBA ratio of C3-C7 1.33, 0.98, 2.21, 1.84, 1.48 **b-f** SEA/VBA ratio of C3-7(3.23, 2.80, 3.24, 2.49, 2.31)

胸段脊柱过屈(C7S增大)显著相关。

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