Vertebral Ankylosis is Associated with Poorer Cervical Paraspinal Muscle Health

Alex Ngan, Junho Song¹, Austen Katz², Priya Duvvuri, John Fallon, Luke C Zappia, Bongseok Jung, David Essig, Sohrab Virk

¹Mount Sinai Hospital, ²Northwell Health - Long Island Jewish Medical Cent

INTRODUCTION: Spinal disorders such as ankylosing spondylitis (AS) and diffuse idiopathic skeletal hyperostosis (DISH) are associated with ankylosis of the vertebrae, which can lead to spinal stiffness and back pain. The biomechanical changes secondary to vertebral ankylosis can predispose patients to spinal deformity, degeneration, and fractures. While prior studies have evaluated the incidence and outcomes of spine surgery in patients with vertebral ankylosis, the potential influence of vertebral ankylosis on paraspinal muscle health has not been previously investigated. Given the abundance of recent literature correlating paraspinal muscle health with functional outcomes in spine patients, investigation of this topic may provide additional insight regarding the complex pathophysiology of vertebral ankylosis. Therefore, this study aimed to evaluate the association between vertebral ankylosis and MRI-based measurements of cervical paraspinal muscle health.

METHODS: This is a retrospective review of a consecutive series of patients with degenerative cervical spine disease. Patients with confirmed diagnoses of AS or DISH were identified and matched with patients without AS or DISH based on age, sex, and body mass index. Radiological muscle health measurements were performed on axial T2-weighted MRI at all intervertebral levels between C2 and T1. Bilateral cross-sectional areas (CSA) of the cervical deep flexors (DF) and deep extensors (DE) were measured. The degree of muscle fatty infiltration was assessed by applying the Goutallier classification. Muscle health measurements were compared between the two matched cohorts.

RESULTS: Seventeen patients with diagnosis of AS or DISH were matched with 17 patients without AS/DISH diagnoses. Compared to the control group, patients with vertebral ankylosis had smaller DE CSA at C2-C3 (351.3 vs. 590.2 mm², p=0.048), C4-C5 (327.6 vs. 572.4 mm², p=0.027), C5-C6 (360.6 vs. 554.0 mm², p=0.039), and C6-C7 (441.1 vs. 644.7 mm², p=0.033). There was no significant association between vertebral ankylosis and DF CSA at any level between C2-T1 (p>0.05). In addition, patients with vertebral ankylosis had higher average Goutallier grades at C5-C6 (2.92 vs. 1.85, p<0.001) and C7-T1 (3.23 vs. 2.02, p<0.001) (Table 1).

DISCUSSION AND CONCLUSION: Vertebral ankylosis was found to be associated with worse cervical paraspinal muscle health at multiple intervertebral levels. On average, patients with diagnoses of AS or DISH were found to have smaller CSAs of cervical DE muscles. Vertebral ankylosis was also associated with greater amounts of paraspinal muscle fatty infiltration, particularly at the lower cervical levels. These findings highlight a potential link between vertebral ankylosis and paraspinal muscle health. Additional analyses including greater sample sizes are warranted to confirm these findings.

Ankylosis			
	Ankylosis	Control	
Muscle Health Parameter	(N=17)	(N=17)	p-value
C2-C3			
Deep Extensors CSA	351.3 ± 173.2	590.2 ± 465.3	0.048
Deep Flexors CSA	148.4 ± 102.2	181.8 ± 67.0	0.167
Goutallier Grade	2.54 ± 0.88	2.08 ± 1.19	0.135
C3-C4			
Deep Extensors CSA	333.8 ± 151.0	527.6 ± 417.4	0.070
Deep Flexors CSA	132.2 ± 54.6	172.4 ± 92.3	0.183
Goutallier Grade	3.00 ± 0.71	2.43 ± 0.92	0.107
C4-C5			
Deep Extensors CSA	327.6 ± 117.1	572.4 ± 371.9	0.027
Deep Flexors CSA	137.4 ± 49.9	178.0 ± 73.8	0.132
Goutallier Grade	2.54 ± 0.88	2.38 ± 0.73	0.327
C5-C6			
Deep Extensors CSA	360.6 ± 144.7	554.0 ± 349.0	0.039
Deep Flexors CSA	123.9 ± 42.9	170.6 ± 136.7	0.126
Goutallier Grade	2.92 ± 0.86	1.85 ± 0.69	<0.001
C6-C7			
Deep Extensors CSA	441.1 ± 257.0	644.7 ± 391.8	0.033
Deep Flexors CSA	125.4 ± 41.8	189.5 ± 122.9	0.094
Goutallier Grade	2.69 ± 0.95	2.20 ± 0.78	0.113
C7-T1			
Deep Extensors CSA	453.2 ± 220.5	612.5 ± 304.2	0.063
Deep Flexors CSA	129.5 ± 54.2	184.1 ± 104.6	0.108
Goutallier Grade	3.23 ± 0.60	2.12 ± 0.86	<0.001

Table 1. Cervical Paraspinal Muscle Health in Patients With and Without Vertebral

 Goutallier Grade
 3.23 ± 0.60 2.12 ± 0.86 <0.00

 Bold values indicate statistical significance (p < 0.05). CSA, cross-sectional area (mm²).