Assessment of Age-Related Variation in Normative Cervical Neuroforaminal Dimensions

Kai Nguyen[1], Zachary Brandt, Jacob Anees Razzouk[2], David Shin, Ethan Vyhmeister, Wayne K Cheng, Olumide A Danisa[3]

[1]Loma Linda University School of Medicine, [2]Loma Linda University, [3]Loma Linda University Health

INTRODUCTION: Although the radiographic parameters for diagnosing cervical central canal stenosis are well described, parameters for the diagnosis of cervical neuroforaminal stenosis (CNFS) are not. In order to develop a definitive criteria for diagnosis of CNFS, a standardized definition of what constitutes "normal" neuroforaminal anatomy must first be established. The utility of understanding normative measures is clear in the current screening approach for osteoporosis, whereby a patient's DEXA score is compared to what is typical for someone of the same age. The goal of this study was two-fold: (1) to use computed tomography (CT) of patients without back pain or spinal pathology to establish normative CNFD across multiple age groups and (2) to analyze trends in normative CNFD according to age.

METHODS: Cervical CTs of 1,457 patients free of back pain or spinal pathology were reviewed to measure CNFD, defined as follows: axial width, craniocaudal height, and area. Patients were divided into four age groups: 18-35, 36-50, 51-64, and 65+ years. Statistical analyses were performed to assess differences in CNFD based on age group.

RESULTS: Without differentiating between sides or disc level, the mean overall CNFD for the 18-35 year-old cohort were 6.43 mm for width, 9.28 mm for height, and 58.85 mm^2 for area. For the 36-50 year-old cohort, dimensions were 5.89 mm for width, 8.63 mm for height, and 52.78 mm^2 for area. For the 51-64 year-old cohort, dimensions were 5.29 mm for width, 8.52 mm for height, and 48.93 mm^2 for area. Finally, the 65+ year-old cohort had dimensions of 5.09 mm for width, 8.16 mm for height, and 45.91 mm^2 for area. Significant differences were observed between age groups for all three CNFD on both the left and right sides at every disc level C2-T1. With very few exceptions, CNFD decreased progressively from the younger to older age groups, with the 18-35 year-old cohort having the largest values and the 65+ year-old cohort having the smallest values.

DISCUSSION AND CONCLUSION: This study utilized CT of 1,457 patients free of back pain or spinal pathology to describe normative cervical neuroforaminal dimensions across multiple age groups. In the studied population, normative CNFD decreased progressively with age. The results of our study may have utility in diagnosis of CNFS.

Table 1. Mean (mm) Cervical NFD Across Age Groups

Disc Level	Age Group	Left NFD Width		Left NFD Height		Left NFD Area		Right NFD Width		Right NFD Height		Right NFD Area	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
C2-C3	18-35	6.76	1.81	9.34	2.76	63.82	23.94	6.82	1.85	9.29	3.33	63.63	24.27
	36-50	6.50	1.81	9.01	7.65	57.66	22.83	6.46	1.85	8.57	1.66	57.38	22.62
	51-64	5.87	1.94	9.31	8.60	54.25	21.15	6.02	1.90	8.56	1.62	55.29	21.32
	65+	5.77	1.87	8.12	1.80	52.48	20.27	6.04	1.72	8.38	3.40	53.57	19.20
C3-C4	18-35	6.21	1.62	8.70	3.67	54.55	18.47	6.16	1.58	8.66	2.75	55.25	19.14
	36-50	5.65	1.59	8.03	1.64	50.50	18.41	5.58	1.62	7.89	1.62	50.28	20.63
	51-64	4.94	1.73	7.99	1.66	46.80	18.37	5.04	1.73	7.67	1.73	46.86	18.16
	65+	4.59	1.75	7.55	1.81	44.00	16.40	4.61	1.62	7.41	1.66	44.69	16.54
C4-C5	18-35	6.35	1.53	9.01	1.79	57.86	19.09	6.28	1.51	8.98	3.06	58.33	19.55
	36-50	5.72	1.62	8.50	1.95	53.83	19.08	5.79	1.65	8.24	1.80	52.73	19.83
	51-64	4.79	1.86	8.29	1.71	48.18	17.54	5.03	1.57	8.16	1.72	48.20	19.21
	65+	4.28	1.72	7.93	1.76	45.64	17.58	4.58	2.04	7.57	1.61	44.07	17.37
C5-C6	18-35	6.30	1.51	9.58	4.38	59.39	19.45	6.40	1.47	9.39	3.55	59.86	19.16
	36-50	5.33	1.66	8.68	1.73	49.51	17.73	5.52	1.63	8.63	1.74	51.07	18.21
	51-64	4.49	1.67	8.49	1.78	46.03	16.60	4.70	1.63	8.29	1.70	45.06	16.51
	65+	4.25	1.73	8.19	1.90	41.31	16.74	4.55	1.74	7.98	1.77	42.43	17.17
C6-C7	18-35	6.44	1.65	9.50	2.08	58.57	18.97	6.52	1.56	9.64	2.83	59.79	20.79
	36-50	5.80	1.77	8.95	1.78	52.89	18.53	5.90	1.69	8.87	1.77	54.46	19.50
	51-64	5.08	1.89	8.49	1.93	45.90	17.50	5.65	4.05	8.67	1.85	47.74	19.28
	65+	4.93	2.09	8.60	4.84	41.84	16.80	5.20	1.95	8.20	1.72	42.76	15.22
C7-T1	18-35	6.40	1.78	9.65	2.49	57.37	20.76	6.48	1.66	9.59	2.16	57.79	20.41
	36-50	6.16	1.78	9.02	2.04	51.89	19.04	6.24	1.78	9.43	6.33	51.12	19.50
	51-64	5.93	1.90	9.23	2.08	51.59	16.62	5.88	1.97	9.05	1.97	51.20	17.34
	65+	6.12	1.91	9.24	4.05	48.29	16.55	6.16	1.84	8.80	1.97	49.81	17.12