THE RELATIONSHIP BETWEEN DISC DEGENERATION AND MORPHOLOGIC CHANGES IN THE INTERVERTEBRAL FORAMEN OF THE CERVICAL SPINE: A CADAVERIC MRI AND CT STUDY.

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INTRODUCTION: The pathogenesis of cervical spondylosis involves degenerative changes in the intervertebral disc and subsequent morphologic changes in the zygapophyseal joints and intervertebral foramen. Nerve root compression in the intervertebral foramen is a frequent sequela of cervical spondylosis. The purpose of this study is to investigate the relationship between disc degeneration and morphologic changes in the intervertebral foramen, including the effect on the nerve root.

MATERIALS AND METHODS: Seven fresh frozen human cadavers were dissected from C1 to T1, preserving the ligaments, capsules, intervertebral disc, and the neural structures. The age of the cadavers ranged from 44 to 85 years with a mean of 65.3 years. Plain radiographs were obtained to rule out any gross pathology aside from cervical spondylosis. The specimens were scanned with MRI (1.5T, General Electric, Milwaukee, WI). T1 weighted MR scans were obtained from C2 to T1 in the mid-sagittal plane to assess degeneration of the intervertebral disc. Disc degeneration was graded from I to V using the Thompson grading scale. In order to evaluate nerve root compression in the intervertebral foramen, the foramina were imaged in the 45° oblique plane from C2-3 to C7-T1. The nerve roots were observed as normal, contact, or deformed. The specimens were frozen in the neutral position and then scanned through CT scan in the upright position. Direct mid-sagittal and 45° oblique images were obtained to measure the dimensions of the intervertebral disc heights, foraminal height, width, area, and segmental angles. All the measurements were made using a computer aided image analysis system, and repeated three times. The data were analyzed using multiple correlation and chi-square tests.

RESULTS: A total of 35 intervertebral discs and 70 foramina were analyzed. In terms of disc degeneration, 0% had grade I, 8.6% had grade II, 31.4% had grade III, 17.1% had grade IV, and 42.9% had grade V. There was no correlation between disc degeneration and cervical level of the disc in this old age group of cadavers. Disc degeneration was inversely correlated with disc heights (r=0.714 for middle height, r=0.677 for anterior height, r=0.578 for posterior height). There was a significant correlation between disc degeneration and foraminal width (p<0.005) and foraminal area (P<0.05), but not with foraminal height.
Disc height was correlated with foraminal width but not with height. The segmental angles were decreased in more advanced degenerated discs. Nerve roots were noted to be normal in 22.8% of specimens, contacted in 18.6%, and deformed in 58.6%. There was a correlation between nerve root compression and decreased foraminal width and area (p<0.005). Critical mean values for nerve root contact were 4.92mm for the foraminal width, mean=5.31mm for foraminal area, and 1.67mm for posterior disc height.

DISCUSSION AND CONCLUSION: This study investigated the relationship between disc degeneration and morphologic changes in the intervertebral foramen. As the intervertebral disc ages and degenerates, the disc height diminishes with concomittant morphologic changes in the foramen. It was found that the foraminal width is more significantly affected than the height. It could be interpreted that with cervical spondylosis, cervical lordosis is decreased and the intervertebral foramen is narrowed more in the anterior-posterior direction. This information and critical dimensions of the intervertebral foramen for nerve root compression should help in the diagnosis of foraminal stenosis of the cervical spine in patients presenting with cervical spondylosis and radiculopathy.