Modified K Line in MRI is a Powerful Tool to Predict Clinical Outcomes in Patients with Non-Lordotic Alignment after Laminoplasty for a Treatment of Cervical Spondylotic Myelopathy

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Introduction: We have previously reported the modified K-line (mK-line), which was defined as a line connecting the midpoints of the spinal cord at C2 and C7 on T1 weighted sagittal MRI, can predict postoperative insufficient decompression in patients with cervical spondylotic myelopathy (CSM) who underwent laminoplasty. Although it is very important for spine surgeons to predict postoperative clinical outcomes, particularly in patients with cervical malalignment such as kyphotic or sigmoid alignment, before selecting a surgical procedure for the treatment of CSM, few studies thus far has assessed a relationship between postoperative outcomes and anticipated spinal cord shifting quantified on MRI. The purpose of this study is to investigate whether mK-line can be a powerful tool to predict postoperative clinical outcomes in patients with non-lordotic alignment.

Methods: Sixty-one consecutive patients who underwent laminoplasty for the treatment of CSM between 2000 and 2011 at our hospital were retrospectively reviewed. Cervical sagittal alignment, as classified by Kamata and Matsumoto et al., was assessed based on lateral neutral X-ray, and then 23 patients whose cervical alignment was not lordosis were enrolled. An interval between the preoperative mK-line and anterior structure of the spinal canal at each segment of C3 to C6 levels (INTn; n=3-6, Figure 1) was measured on sagittal T1-weighted MRI. The sum of the INTn (INTsum=INT3+INT4+INT5+INT6) was then calculated as anticipated degree of posterior cord shifting. In addition, we defined INTmin as the minimum interval among INTn in each patient (Figure 1). The Japanese Orthopedic Association (JOA) scoring system and recovery rate of the JOA score for cervical myelopathy was evaluated as clinical outcomes.

Results: The mean age was 62.5 (± 9.1) years. The mean JOA score was 9.2 (± 3.0) points before surgery and 12.5 (± 2.8) points at final visit, respectively, yielding that mean recovery rate of JOA score was 42.1 (± 23.5) %. The number of patients with non-lordotic alignment was 8 for sigmoid, 7 for straight, 5 for kyphosis, and 3 patients for reversed-sigmoid alignment, respectively. Cervical alignment on MRI was closely associated with that on lateral neutral X-ray in each patient. A linear regression model demonstrated a significant correlation between INTmin and recovery rate of JOA score in these patients (y= 6.347x+22.36, y=the JOA score recovery rate, x=INTmin, r²=0. 25, p=0.018, Figure 2), whereas INTsum was not associated with recovery rate. From this analysis, recovery rate greater than 50% requires INTmin of > 4.35mm preoperatively.

Conclusion: The current study revealed that the preoperative mK-line can predict clinical outcomes in patients with non-lordotic alignment following laminoplasty by the measurement of INTmin, rather than that of INTsum. These results indicate that it might be important to recognize the apex of the kyphosis or anterior compression in presence of malalignment as a risk factor for lack of posterior cord shifting after laminoplasty, and that anterior decompression with fixation or posterior decompression with fusion should be applied to such cases.