

Classification of Sagittal Imbalance Based on Spinal Alignment and Compensatory Mechanisms

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Introduction

Sagittal balance is an independent predictor of clinical outcomes in spinal care. Surgical treatment is challenging and jeopardized by frequent complications. Guidelines for surgical treatment are currently not based on a classification of the disease. A comprehensive classification of sagittal balance, based on regional deformities and compensatory mechanisms combined with deformity patterns is proposed. Though the sagittal shape of the spine can change due to degeneration or trauma, correlations between sagittal shape parameters and pelvic incidence (PI) have been described. Pelvic incidence is not changed by degeneration, thus representing a permanent source of information on the original sagittal shape of the spine.

Material and Methods

A total of 128 full-spine lateral standing radiographs of patients with different spinal conditions were evaluated and classified by one rater. One random subseries of 35 patients was evaluated by two raters for calculation of interrater agreement. Spinopelvic parameters were measured in all the radiographs. The internal validity of the classification system was evaluated comparing the values of regional sagittal parameters that distinguish one category from the others.

Results

Eight different patterns were identified regarding the site of the deformity and the presence of compensatory mechanisms: cervical, thoracic, thoracolumbar junction, lumbar, lower lumbar, global and pelvic kyphosis, and normal sagittal alignment. Interrater agreement was almost perfect ($\kappa = 0.963$). Statistically significant differences were found comparing the means of selected sagittal spinopelvic parameters that conceptually divide pairs or groups of categories: C2-C7 SVA for cervical kyphosis versus all other patients, TK-PI mismatch for thoracic kyphosis versus all other patients, T11-L2 kyphosis for thoracolumbar kyphosis versus all other patients, global alignment (LL? TK-PI) and SVA for lumbar kyphosis versus global kyphosis, and pelvic tilt for pelvic kyphosis versus lumbar, lower lumbar, and global kyphosis.

Conclusion

A comprehensive classification of sagittal imbalance is presented. This classification permits a better interpretation of the deformity and muscle forces acting on the spine, and helps surgical planning. Preliminary validation has been provided.