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The correlation between sagittal balance and lower extremities alignment in patients with back pain

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Introduction

Spinopelvic alignment in sagittal plane is known be related to low back pain (LBP). Additionally, leg length discrepancy and abnormal foot arch have been proposed as possible risk factors for LBP. However, there is lack of the previous studies about the relationship between sagittal balance and lower extremities alignment measured in plain X-ray. This study aims to analyze an association between sagittal spinopelvic parameters and lower extremities radiologic alignments in for patients with LBP.

Methods

Medical records of patients with LBP between August 2014 and June 2019 were reviewed. Patients who had undergone back or leg surgery were excluded. Their standing X-rays in barefeet such as lateral view of whole spine with hip joints, orthoradiograms of whole lower extremities, and lateral view of both feet were assessed.The radiographic parameters examined were thoracic kyphosis (TK), lumbar lordosis (LL), pelvic incidence (PI), pelvic tilt (PT), sacral slope (SS), sacrofemoral distance (SFD), sagittal vertical axis (SVA), spinosacral angle (SSA), C7 plumbline/sacrofemoral distance ratio (C7PL/SFD), quadriceps angle (Q-angle), leg length discrepancy (LLD) and calcaneal inclination (CI) (Figure 1). All measurements were performed using Picture Archiving Communication System (PACS, M-view; Marosis, Seoul, Korea) software. Spearman's correlation test was used on all parameters. Statistical analysis was performed using SPSS version 21 (SPSS Inc., Chicago, IL, USA).

Results

A total of 15 patients with chronic low back pain were enrolled for this study. Table 1 summarizes correlations between all parameters. As in the previous studies, the correlation between TK and LL was significant. All of the sagittal spinopelvic parameters had no significant correlation with Q-angle and LLD. However, CI measured in lateral view of both feet showed a significant negative correlation with PI and SFD.

Conclusion

Sagittal spinopelvic parameters did not correlate with Q-angle and LLD, but showed a significant correlation with CI. These findings suggest that the evaluation of foot longitudinal arch alignment deformity is necessary as well as sagittal balance in patients with chronic LBP. Further study with larger sample size will be required to find more reliable results.

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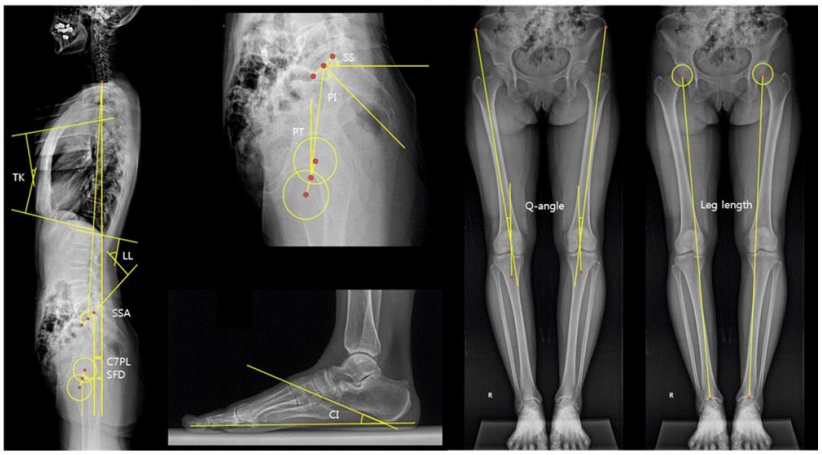

Abbreviations: TK, thoracic kyphosis; LL, lumbar lordosis; PI, pelvic incidence; PT, pelvic tilt; SS, sacral slope; SFD, sacrofemoral distance; SVA, sagittal vertical axis; SSA, spinosacral angle; C7PL/SFD, C7 plumbline/sacrofaemoral distance ratio; Q-angle, quadriceps angle; CI, calcaneal inclination

Figure 1. Radiologic measurement of sagittal spinopelvic parameters and lower extremities alignment

Table 1. Spearman's correlation coefficients between all parameters for patients with chronic low back pain

Parameter	LL	PI	PT	SS	SFD	SVA	SSA	C7PL/SFD	Q-angle	LLD	CI
TK	**0.646****	0.029	-0.111	0.214	-0.143	0.139	0.304	0.182	-0.371	0.404	-0.023
LL		-0.089	-0.393	0.468	-0.479	0.254	**0.746****	0.189	-0.254	0.132	0.209
PI			**0.614***	0.511	**0.575***	-0.004	0.304	0.057	-0.257	-0.007	**-0.551***
PT				-0.129	**0.846****	-0.136	-0.261	-0.132	-0.061	-0.136	-0.294
SS					-0.189	0.271	**0.764****	0.293	-0.054	-0.071	-0.014
SFD						-0.321	-0.296	-0.325	-0.314	-0.086	**-0.534***
SVA							0.071	**0.946****	0.204	0.350	0.131
SSA								-0.068	-0.146	-0.089	0.029
C7PL/SFD									0.139	0.386	0.030
Q-angle										-0.089	0.295
LLD											-0.446

* p<0.05, ** p<0.01; Statistically significant correlation coefficient
Abbreviations: TK, thoracic kyphosis; LL, lumbar lordosis; PI, pelvic incidence; PT, pelvic tilt; SS, sacral slope; SFD, sacrofemoral distance; SVA, sagittal vertical axis; SSA, spinosacral angle; C7PL/SFD, C7 plumbline/sacrofaemoral distance ratio; Q-angle, quadriceps angle; LLD, leg length discrepancy; CI, calcaneal inclination