Assessing Pelvic Configuration and Its Association with Cervico-Scapular Morphological Changes in FHP Populations

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FHP 환자군에서 골반 형태 평가 및 경추-견갑골 형태학적 변화와의 연관성

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Abstract

The present study investigates the correlations between structural changes in the cervical vertebra and pelvic alignment in individuals with forward head posture. 30 subjects (19 males and 11 females) who met inclusion criteria were diagnosed with forwar head posture. The pelvic alignment and cervical and scapular structural changes for each subject was measured using craniovertebral angle(CVA), rounded shoulder angle(RSA), horizontal gap between the tragus and acromion process, pelvic inclination and pelvic shift. Correlation analysis between CVA and PI showed a negative correlation, with $r=-0.423$ ($p<0.01$). In addition, a negative correlation between CVA and PS was observed, with $r= -0.521$ ($p<0.05$). In the correlation analysis between RSA and PS showed a negative correlation, with $r=-0.768$ ($p<0.01$). In the correlation analysis between HG and PS showed a positive correlation, with $r=0.569$ ($p<0.01$). A positive correlation, with $r=0.541$, was observed between CVA and RSA. A negative correlation, with $r=-0.582$, was also observed between CVA and HG. We conclude that there is a positive correlation between the structural changes in the cervical vertebra and scapula and pelvic alignment in patients with FHP. This finding suggests that the treatment of FHP should include consideration of the spine and pelvis.

1. Introduction

Forward head posture (FHP) is characterized by anterior head displacement relative to the vertical plumb line,[1] defined by Peterson-Kendall as external auditory meatus anterior to shoulder joint line. Prevalent due to prolonged smartphone/computer use, FHP alters cervical alignment, increasing stress on neck muscles (shortened sternocleidomastoid, levator scapulae, cervical extensors; weakened upper trapezius).[2,3,4] It associates with upper crossed syndrome involving rounded shoulders.[5] Assessment methods include craniovertebral angle (CVA) and visual inspection, with studies linking CVA to neck disability and coexisting postural deviations.[6,7,8,9] While prior research explores cervical-shoulder relationships, no studies examine FHP's impact on pelvic alignment, prompting this investigation into cervical-pelvic structural correlations.

2. Materials and Methods

2.1 Participants

A total of 36 individuals were initially recruited, but 6 were excluded due to non-participation or not meeting criteria, leaving 30 participants (19 males, 11 females) diagnosed with FHP [Table 1]. The study took place over six weeks in late 2018 at the SNS rehabilitation center, with ethical approval from Daegu University. All participants were aged 25-50 and met specific inclusion criteria: FHP diagnosis with an acromion-to-ear vertical line >2.5 cm, craniovertebral angle <50°, rounded

shoulder angle <52°, no pain or movement limitation in the neck, shoulders, or pelvis, and no history of relevant musculoskeletal or neurological disorders, surgery, or chronic headache.

[Table 1] General characteristics of subjects (n= 30)

Variable	Mean ± SD
Sex (M/F)	19/11
Age (year)	36.70 ± 5.70
Height (cm)	171.89 ± 5.16
Weight (kg)	68.65 ± 10.30
CVA (°)	45.07 ± 2.92
RSA (°)	40.78 ± 8.86
HG (cm)	4.13 ± 1.39
PI (°)	6.27 ± 1.14
PS (cm)	−5.29 ± 2.82

SD, standard deviation

2.2 Study design

Pelvic alignment and cervical/scapular structural changes were assessed in each subject using CVA, RSA, the horizontal distance between the tragus and acromion, pelvic inclination, and pelvic shift. Two physiotherapists performed these measurements with a digital camera and Palpation Meter (PALM). Each measurement was repeated three times, and the average was used. Results were reported as mean ± standard deviation.

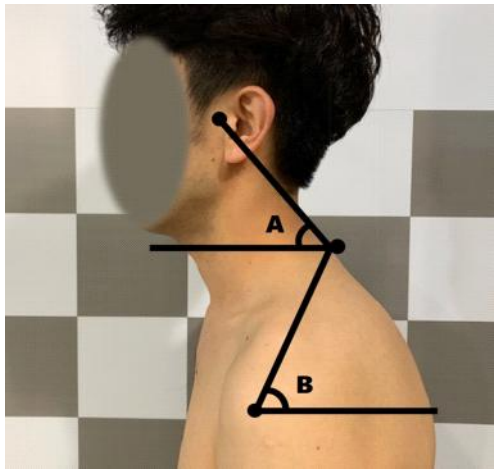
2.3 Outcome measures

2.3.1 Craniovertebral Angle (CVA)

A pendulum-fixed vertical thread was used to measure CVA in forward head posture. Markers were placed on the C7 spinous process and tragus (Fig. 1a). A horizontal digital camera (Canon EOS 7D Mark II, 1.5m distance) captured kinematic data, analyzed via ImageJ. High reliability (ICC = 0.88).

2.3.2 Rounded Shoulder Angle (RSA)

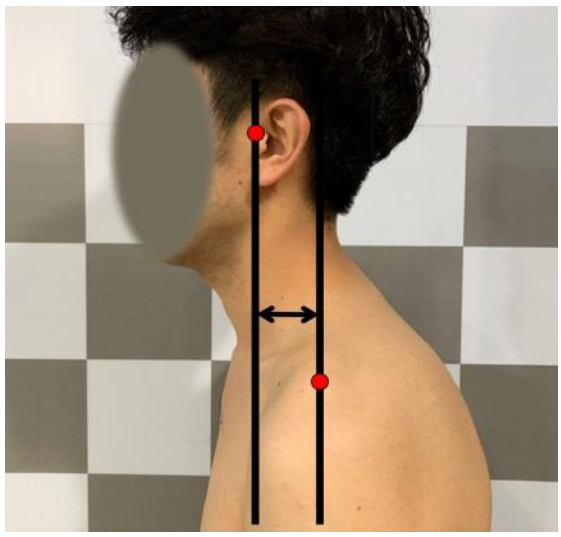
Identical vertical thread setup measured RSA. Markers were attached to the C7 spinous process and humerus midpoint (Fig. 1b). The same camera setup and ImageJ analysis were applied.



[Fig. 1] A: craniovertebral angle; B: rounded shoulder angle

2.3.3 Horizontal Gap Between Tragus and Acromion Process

A pendulum-fixed vertical thread measured the horizontal gap in forward head posture. Markers were placed on the acromion and tragus. A digital camera (Canon EOS 7D Mark II, 1.5m distance, horizontal) captured data, analyzed via ImageJ.



[Fig. 2] Horizontal gap between the tragus and acromion process

2.3.4 Pelvic Inclination

Pelvic inclination was measured using the PALM, a clinically validated tool with an inclinometer and two caliper arms (Fig. 3). Subjects stood barefoot, feet apart,

and leaned their anterior femurs on a stable table. The inspector contacted the anterior superior iliac spine (ASIS) and posterior superior iliac spine (PSIS) with the PALM's caliper arms to measure pelvic tilt. The PALM demonstrated high intratest (ICC = 0.90) and inter-rater (ICC = 0.85) reliability.

[Fig. 3] PALM; Performance Attainment Associates, St. Paul, MN, USA

2.3.5 Pelvic Shift

Pelvic shift was measured using a ceiling-fixed pendulum thread as a vertical reference. Markers were placed on the greater trochanter of the femur and tragus. A Canon EOS 7D Mark II camera (1.5m distance, horizontal alignment; Fig. 4) captured kinematic data, analyzed via ImageJ software.

[Fig. 4] pelvic shift

2.4 Statistical analysis

SPSS for Windows (version 22.0) was used to analyze the data in this study. The correlations of CVA with the RSA and HG, in addition to those of PI, PS were examined. Pearson correlation coefficient was used for correlation analysis, and the statistical significance was set at $\alpha = .05$.

3. Results

Significant correlations were observed: CVA negatively correlated with pelvic inclination (PI; $r = -0.423$, $p<0.01$) and pelvic shift (PS; $r = -0.521$, $p<0.05$). RSA exhibited a strong negative correlation with PS ($r = -0.768$, $p<0.01$), while HG positively correlated with PS ($r = 0.569$, $p<0.01$). CVA also showed a positive association with RSA ($r = 0.541$) and a negative link with HG ($r = -0.582$). All results are detailed in Table 2.

Table 2. Correlation between CVA, RSA, HG, PI, and PS

	CVA	RSA	HG	PI	PS
Mean	45.07± 2.92	40.78± 8.86	4.13± 1.39	6.27±1. 14	−5.29± 2.82
CVA	1	.541**	−.582**	−.423*	−.521**
RSA	.541**	1	−.669**	0.084	−.768**
HG	−.582**	−.669**	1	0.247	.569**
PI	−.423*	0.084	0.247	1	0.038
PS	−.521**	−.768**	.569**	0.038	1

Mean ± SDa, *p<0.05, **p<0.01, CVA, craniovertebral angle; RSA, rounded shoulder angle; HG, horizontal gap between the tragus and acromion process; PI, pelvic inclination; PS, pelvic shift.

4. Conclusions

In conclusion, there is a positive correlation between the structural changes in the cervical vertebra and scapula and pelvic alignment in patients with FHP. This finding suggests that the treatment of FHP should include consideration of the spine and pelvis.

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