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Comparison of Biomechanical Parameters on Lower Limbs in Chronic Stroke Patients with FAC 3 and 4

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Background and Purpose

- As a highly prevalent neurological disease worldwide, stroke is a primary cause of hemiplegia and leads to substantial impairments in physical mobility.
- While extensive studies have investigated gait patterns in both healthy individuals and stroke survivors capable of independent ambulation, studies focusing on stroke patients with dependent gait remain limited.
- To fill this gap, the present study aimed to compare biomechanical parameters of stroke patients classified as Functional Ambulation Category (FAC) level 3 and 4.

Methods

Study Design and Participants

- Prospective and case-control study design
- The inclusion criteria were stroke patients aged 20 years or above, over 1month of stroke onset, with National Institute of Health Stroke Scale (NIHSS) score ranging from 1 to 20.
- The exclusion criteria were with systemic infection symptoms, cognitive impairment, any condition deemed inappropriate for participation by the researchers.
- Finally, 12 participants were recruited and categorized into FAC level 3 or 4 by a qualified physical therapist in Bundang CHA hospital.
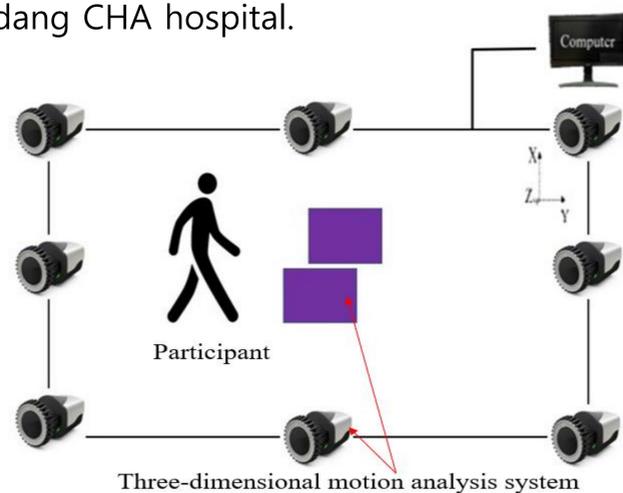

Figure 1. Experimental environment on motion capture

- Three-dimensional motion analysis was employed to assess biomechanical parameters during level walking, including maximum and minimum joint angles, range of motion (ROM), and peak values of force, moment, power, and ground reaction force (GRF).
- Conventional functional assessments on lower limbs were conducted using the Medical Research Council (MRC) scale and passive ROM to compare functional disparities between the groups.

Statistical Analysis

- Depending on the results of the normality test, statistical analyses were performed using either the Mann-Whitney U test or the independent t-test using SPSS version 25.
- The statistical power was set at $p < 0.05$

Results

Demographic information of participants

Characteristics	FAC 3 group (n=6)	FAC 4 group (n=6)
Gender (male/female)	4/2	4/2
Age (years)	67.0 (63.0-70.5)	69 (59.8-77.8)
Stroke type (Infarction/ Hemorrhage)	3/3	5/1
Height (cm)	163.0 (157.3-172.2)	162.0 (157.6-170.0)
Weight (kg)	62.15 (51.9-73.4)	60.20 (55.7-65.3)
Onset duration (days)	1179.5 (491.0-1948.8)	1177.0 (810.5-1836.5)
Unaffected side (right/left)	3/3	3/3

Values are expressed as the median (interquartile range).

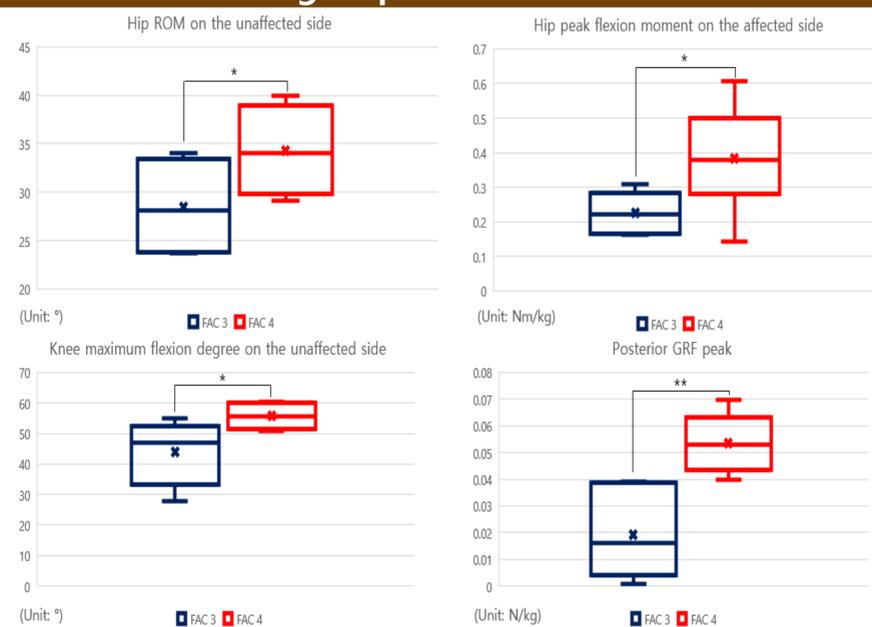### Comparison of Biomechanical Parameters between FAC 3 and FAC 4 groups

Figure 2. Box and whisker plots indicating comparisons of biomechanical parameters between FAC 3 and FAC 4 groups. *$p<0.05$, **$p<0.01$

- FAC 4 group showed a significantly greater ROM on the unaffected side (FAC 4: 34.32° vs. FAC 3: 28.50°; $p<0.05$) and higher peak flexion moments on the affected side (FAC 4: 0.384 Nm/kg vs. FAC 3: 0.226 Nm/kg; $p<0.05$) than those of FAC 3 group.
- FAC 4 group showed larger flexion degree of knee joints (FAC 4: 55.70° vs. FAC 3: 43.84°; $p<0.05$) and higher GRF posterior peak (FAC 4: 0.053 N/kg vs. FAC 3: 0.019 N/kg; $p<0.01$), both on the unaffected side than FAC 3 group.

Conclusion

- This study could suggest the existence of biomechanical differences between FAC 3 and 4 groups.
- The observed variations in gait parameters between FAC 3 and FAC 4 groups could offer possible insights for the development of targeted rehabilitation strategies for improving independent ambulation in stroke patients according to the individual ambulatory function.

Acknowledgement