ANGULAR VELOCITY CONSTRAINT BETWEEN ANKLE AND HIP JOINTS DURING HUMAN QUIET STANDING.

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During human quiet standing (QS), the segmented body has been considered to play a significant role to maintain the center of gravity of body (COG) above the support area. However, since the angular movements of joints during QS are quite subtle, it is difficult to measure them with high accuracy by conventional methods. Because of this methodological difficulty, how the CNS controls the coordination of body segments has not been fully elucidated.

In this study, we investigated how the coordination between ankle and hip joints is controlled during QS. Angular displacement and velocity of both joints in a sagittal plane were obtained during QS (duration was 30 s) using a CCD laser displacement sensor (LK-2500, Keyence, Japan) with a high resolution $\approx 1\ \mu$m. The data were obtained from 5 normal subjects with informed consent.

In general, the forward (backward) ankle joint movement was compensated by the backward (forward) hip joint movement, however, this constraint was ambiguous and variable from trial to trial. Similar constraint was observed more clearly in the relationship between angular velocity of ankle and hip joints. The principal component analysis revealed that the clear relationship exists between them as: $\dot{\theta}_{hip} = \alpha\dot{\theta}_{ank}$, where $\dot{\theta}_{hip}$ and $\dot{\theta}_{ank}$, respectively, denote the angular velocity of the hip and ankle joints. The value of α (-3.35 ± 0.96) was similar to the theoretical value obtained under the assumption that the velocity of COG is maintained to be 0. These results suggest that, during human QS, the coordination between ankle and hip joints is controlled to reduce the velocity of COG rather than to keep COG at constant position.

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