

A Research on The Development of Walking for a Healthy Toddler

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Abstract

The gait measurement was conducted for a toddler. The results indicated that the proportion of the stance phase increased during the developmental process from two to three years old. In future, we will show the significance of walking evaluation by following the individual developmental processes of young children.

Walking is a basic movement that humans perform on a daily basis. Evaluation of gait can be used to confirm developmental status of children and to diagnose frailty in the elderly.

Several studies on walking have been conducted from various viewpoints. For example, observational gait analysis has been used to confirm developmental status of children¹⁾. Since young children can't understand the instructions given by a doctor, however, the gait test does not seem to be an appropriate method for evaluating gait of the toddler. Otherwise, gait analysis is being performed from an engineering point of view. An optical motion capture enables to evaluate joint angles during walking. It has also been used in large-scale surveys in which the gait of 97 toddlers were evaluated²⁾. However, very few studies which focus on the development of individual gait. Tracking the development of individual gait leads to clarify the development process of toddler.

In this study, the lower limb joint angles of a healthy toddler (at two and at three years old) are measured using an optical 3D motion analysis system. Then, the development of walking is described from changes in joint angles.

A healthy boy participated in the experiment. The gait measurement was conducted twice when he was two years and one month old and three years and ten months old. His height was 0.86 m and his weight was 11 kg when he was two years and one month old. His height was 0.98 m and his weight was 15 kg when he was three years and ten months old. Study approval was obtained from the Research Ethics Committee, Kogakuin University. Informed consent was obtained from the participant and his parent in advance.

The sampling frequency of the optical 3D motion analysis system was 100Hz. Before the measurement, 19 reflective markers were attached to the lower limbs of the participant with reference to the Helen Hayes marker set as shown in Fig. 1. The subject walked with a natural stride and speed.

Fig. 2 shows the results of the left hip joint angles. The positive direction in the vertical axis is flexion. The horizontal axis is 100% for one gait cycle, where

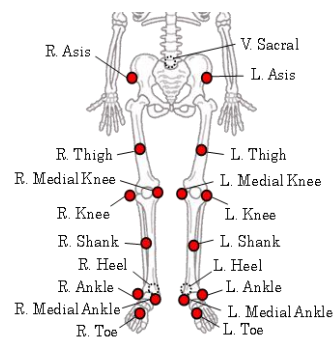


Fig. 1. Marker position

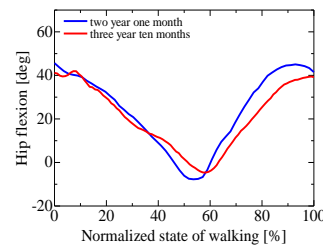


Fig. 2. Hip flexion

0% is the beginning of the stance phase. Both results gradually extend from the beginning of the stance phase and reach the peak of extension at the end of the stance phase. After that, they begin to extend in the swing phase. The results are similar to those of normal adult gait. The distinction between the two results is the length of the stance phase. The stance phase occupies about 50% of the total gait cycle when he is two years old, whereas it occupies about 60% when he is three years old. With growth, the ratio of the stance phase and the swing phase is becoming similar to that of normal adult gait.

References:

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