

Quantitative Evaluation of Gait Disturbance by Ablating Different Rat's Cerebellar Areas

Cerebellar dysfunction is one of the main causes of movement disorder. Especially, patients who have the cerebellar dysfunction suffer seriously from gait ataxia. Diagnoses, prophylaxes, treatments and rehabilitation of cerebellar dysfunction still lack efficiency due to our limited understandings of fundamental cerebellar functions. Therefore, clarifying fundamental cerebellar functions is necessary. Clinical cases and experiments showed that cerebellum has a site specificity of function. Animals that have lesion of different cerebellum areas will have different symptoms. However, information about site specificity of cerebellum is insufficient. There are few studies about how the dysfunction of different area of cerebellum will affect motor function during walking and few quantitative data of the symptoms of gait ataxia. Therefore, quantitative evaluation of symptoms of gait resulting from dysfunction of different parts of cerebellum is important.

In this study, we proposed methods for quantitative evaluation of influences of dysfunctions in different specific cerebellar areas on gait disturbance by experiments on partially decerebellate rat. Physiological studies showed that dysfunctions in cerebellum will cause abnormal posture, decreased muscle tone, lowering movement velocity, influence on emotion function and disequilibrium. To investigate relation between site specificity and those symptoms, as shown in Fig.1, we conducted experiments where we made rats, whose medial area or lateral area of cerebellum has been removed, walk on a treadmill. We measured the motion of their trunk and limbs (Fig.2) and extensor muscle EMG of the limbs, especially the knee angles of mid-stance, their movement velocity on treadmill, voluntary locomotor activity and trembling of the trunk. As a result, there are significant difference of the knee angle of mid-stance between Sham-operated rat and some decerebellate rats: four rats out of five which have removal of medial area, two rats out of three which have removal of bilateral area and two rats out of two which have removal of medial and bilateral area (Fig.3). The result indicates the feasibility of quantitative evaluation of decreased muscle tone with measurement of joint angle.

Keywords: Cerebellar Gait Ataxia, Ablation, Site Specificity of Cerebellum, Posture Control

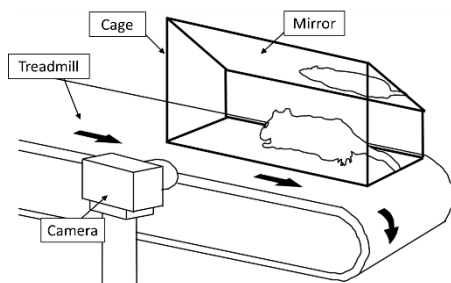


Fig. 1 Illustration of walking experiment.

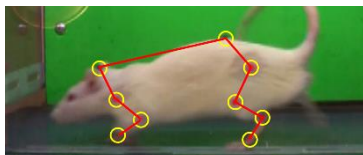


Fig. 2 Tracking of motion of joints in rat.

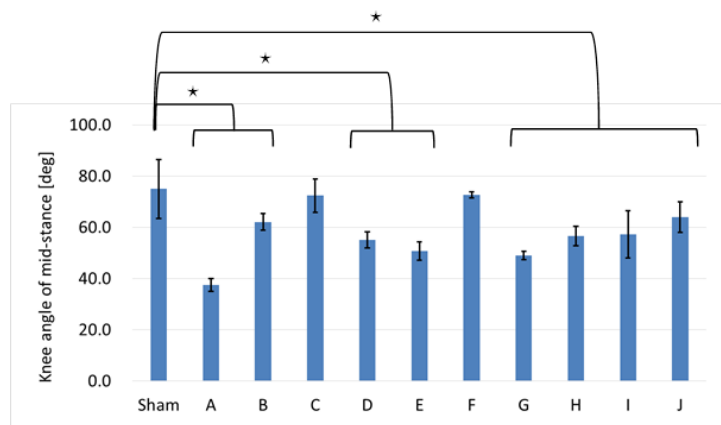


Fig.3. Measurement of knee angle when mid-stance. A-E: removal of medial area. F-H: removal of bilateral area. I-J: removal of medial and bilateral area. Values are shown as means \pm SE. *P < 0.05. All averages are made from 4–12 steps.