Laboratory of Neurophysiotherapy

研究テーマ

ヒトを対象に，神経科学に基づいたニューロリハビリテーション治療を開発すると共に，神経系システムの原理を巨視的に探求する。
臨床的に，脳卒中後運動麻痺者の脳機能再編と運動機能修復を実現するため，脳内で運動を再現する錯覚誘導システムの製品化と臨床試験，ロボティクデバイスの開発に取り組んでいる。

代表的な開発品（KiNvisシステム）

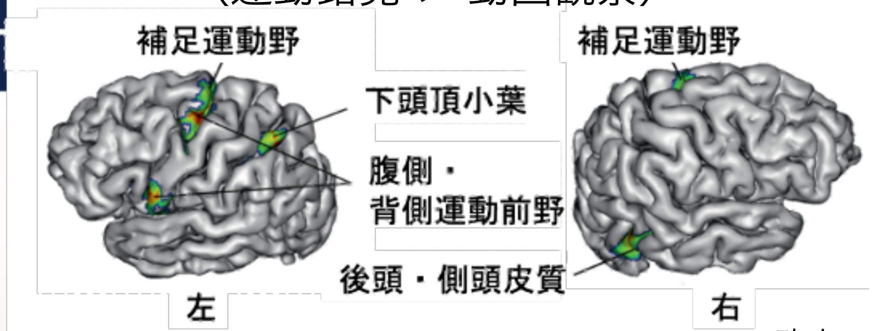
自己運動錯覚誘導システム

自己運動錯覚とは

自己運動錯覚とは，関節運動が生じていないにも関わらず，あたかも自身の四肢が動いているような感覚が引き起こされるものです。

KiNvisの脳機能への影響

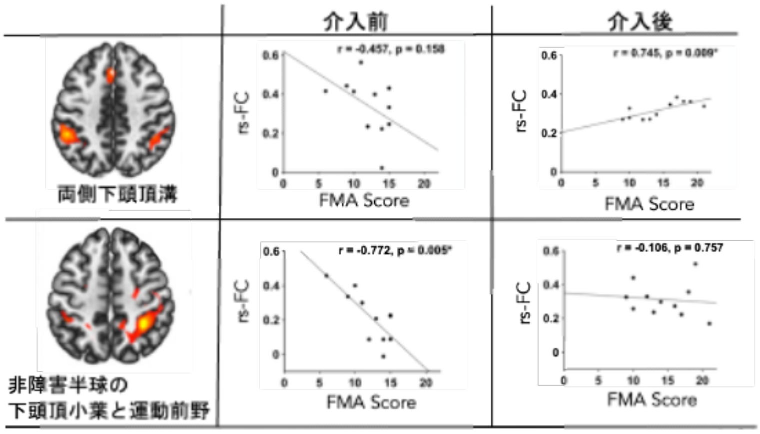
fMRIの結果：運動実行時と類似した脳部位が活動
（運動錯覚 ＞ 動画観察）



(Kaneko F et al., PLOS ONE, 2015; 改変)

KiNvisの慢性期脳卒中患者への適用

KiNvisを用いた錯覚療法と運動療法の組み合わせは，脳機能と運動機能の関係を変化させる。



(Kaneko F et al., Front Syst Neurosci, 2019; 改変)

PLOS ONE

RESEARCH ARTICLE

Brain Regions Associated to a Kinesthetic Illusion Evoked by Watching a Video of One's Own Moving Hand

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OPEN ACCESS

Citation: Kaneko F, Blanchard C, Lebar N, Nazarian B, Kavounoudias A, Romaiguère P (2015) Brain Regions Associated to a Kinesthetic Illusion Evoked by Watching a Video of One's Own Moving Hand. PLoS ONE 10(8): e0131970. doi:10.1371/journal.pone.0131970

Editor: Matthew Longo, Birkbeck, University of London, UNITED KINGDOM

Received: September 1, 2014

Accepted: February 12, 2015

Published: August 19, 2015

Data Availability Statement: Data are available from Figshare: http://dx.doi.org/10.6084/m9.figshare.1441326.

Funding: FK was supported by the Japan Society for the Promotion of Science (JSPS Excellent Young Researcher Overseas Visit Program) and JSPS KAKENHI (Grant-in-Aid for Scientific Research (B) 23300202).

Competing Interests: The authors have declared that no competing interests exist.

Abstract

It is well known that kinesthetic illusions can be induced by stimulation of several sensory systems (proprioception, touch, vision. . .). In this study we investigated the cerebral network underlying a kinesthetic illusion induced by visual stimulation by using functional magnetic resonance imaging (fMRI) in humans. Participants were instructed to keep their hand still while watching the video of their own moving hand (Self Hand) or that of someone else's moving hand (Other Hand). In the Self Hand condition they experienced an illusory sensation that their hand was moving whereas the Other Hand condition did not induce any kinesthetic illusion. The contrast between the Self Hand and Other Hand conditions showed significant activation in the left dorsal and ventral premotor cortices, in the left Superior and Inferior Parietal lobules, at the right Occipito-Temporal junction as well as in bilateral Insula and Putamen. Most strikingly, there was no activation in the primary motor and somatosensory cortices, whilst previous studies have reported significant activation in these regions for vibration-induced kinesthetic illusions. To our knowledge, this is the first study that indicates that humans can experience kinesthetic perception without activation in the primary motor and somatosensory areas. We conclude that under some conditions watching a video of one's own moving hand could lead to activation of a network that is usually involved in processing copies of efference, thus leading to the illusory perception that the real hand is indeed moving.

Introduction

Kinesthetic sensations usually result from movements, whether voluntarily executed or passively imposed. It is therefore difficult to discriminate which components pertain to the motor

frontiers in Systems Neuroscience

CLINICAL TRIAL
published: 17 December 2019
doi: 10.3389/fnsys.2019.00076

A Case Series Clinical Trial of a Novel Approach Using Augmented Reality That Inspires Self-body Cognition in Patients With Stroke: Effects on Motor Function and Resting-State Brain Functional Connectivity

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Edited by:
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Reviewed by:
Soha Saleh,
Kessler Foundation, United States
Birgitta Langhammer,
OsloMet—Oslo Metropolitan University, Norway

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Received: 31 July 2019
Accepted: 27 November 2019
Published: 17 December 2019

Citation:
Kaneko F, Shindo K, Yoneta M, Okawada M, Akaboshi K and Liu M (2019) A Case Series Clinical Trial of a Novel Approach Using Augmented Reality That Inspires Self-body Cognition in Patients With Stroke: Effects on Motor Function and Resting-State Brain Functional Connectivity. Front. Syst. Neurosci. 13:76. doi: 10.3389/fnsys.2019.00076

Barring a few studies, there are not enough established treatments to improve upper limb motor function in patients with severe impairments due to chronic stroke. This study aimed to clarify the effect of the kinesthetic perceptional illusion induced by visual stimulation (KINVIS) on upper limb motor function and the relationship between motor function and resting-state brain networks. Eleven patients with severe paralysis of upper limb motor function in the chronic phase (seven men and four women; age: 54.7 ± 10.8 years; 44.0 ± 29.0 months post-stroke) participated in the study. Patients underwent an intervention consisting of therapy using KINVIS and conventional therapeutic exercise (TherEX) for 10 days. Our originally developed KiNvis™ system was applied to induce KINVIS while watching the movement of the artificial hand. Clinical outcomes were examined to evaluate motor functions and resting-state brain functional connectivity (rsFC) by analyzing blood-oxygen-level-dependent (BOLD) signals measured using functional magnetic resonance imaging (fMRI). The outcomes of motor function (Fugle-Meyer Assessment, FMA) and spasticity (Modified Ashworth Scale, MAS) significantly improved after the intervention. The improvement in MAS scores for the fingers and the wrist flexors reached a minimum of clinically important differences. Before the intervention, strong and significant negative correlations between the motor functions

Abbreviations: KINVIS, Kinesthetic perceptional illusion by visual stimulation; TherEX, Therapeutic exercise; rsFC, Resting-state brain functional connectivity; fMRI, Functional magnetic resonance imaging; CIMT, Constraint-induced movement therapy; M1, Primary motor; S1, Somatosensory; BOLD, Blood-oxygen-level-dependent; ROIs, Regions of interest; TFO, Time from onset; U/L, Upper Limb; SIAS, Stroke impairment assessment set; NMES, Neuromuscular electrical stimulation; EDC, Extensor digitorum communis; FMA, Fugl-Meyer assessment; MAS, Modified ashworth scale; ARAT, Action research arm test; BBT, Box and Block Test; MAL, Motor activity log; AOU, Amount of use; QOM, Quality of movement; MNI, Montreal Neurological Institute; SMG, Supramarginal gyrus; FDR, False discovery-rate; IPL, Inferior parietal lobule; IPS, Intra parietal sulcus; LOC, Lateral occipital cortex; PMd, Dorsal premotor cortex; SMA, Supplementary motor area; SFG, Superior frontal gyrus; SPL, Superior parietal lobule.