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Functional Magnetic Imaging in a Case of Congenital Mirror Movement

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What is known on this subject?

Mirror movements are involuntary movements caused by synchronized mimicry of one side's voluntary muscle movements by the opposite limb's homologous muscles.

What this study adds?

We think that when such complaints are encountered, functional magnetic resonance imaging should primarily be kept in mind and preferred to show the etiopathology non-invasively.

ABSTRACT

Mirror movements are involuntary movements caused by synchronized mimicry of one side's voluntary muscle movements by the opposite limb's homologous muscles. We present a case of mirror movement, which is shown also with functional magnetic resonance imaging.

Keywords: Congenital, EMG, fuctional MRI, mirror

Introduction

Mirror movements are involuntary movements caused by synchronised mimicry of one side's voluntary muscle movements by opposite limb's homologous muscles. Mirror movements can be seen in all limbs but are mostly seen in the upper limbs, especially in hands (1,2). It is normal to see mirror movements among children before the age of 10 because myelination of corpus callosum has not been finished. Among adults, physiological mirror movements can sometimes be seen due to tiredness, intense physical activity, and age. However, persistence and repetition of these movements are considered abnormal (3,4).

There are two main mechanisms for the formation of mirror movements. The first one is abnormal tract of ipsilateral motor corticospinal pathway, and the second one is reduced transcallosal inhibition or increased transcallosal excitation. The etiopathology of mirror movements differs by being congenital or acquired (4). Congenital mirror movements can be physiological or pathological. Mild physiological mirror movements of childhood can frequently be seen due to incomplete development of corpus callosum. Congenital mirror movements generally begin in infancy or early childhood. Progression and fluctuations are unlikely. Frequently seen in the upper limbs, especially in the hands and fingers. Cause mild disability. Expected to disappear between ages seven and ten. Pathological mirror movements on the other hand are permanent. Can be seen with isolated or complex congenital syndromes (Kallmann's

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syndrome, Klippel-feil's syndrome, hypoxic ischemic damage, Usher's syndrome, congenital hemiplegia, Friedrich's ataxia) (5,6).

Acquired mirror movements can be seen with many neurodegenerative diseases such as Parkinson's disease and Corticobasal syndrome. Can also accompany stroke, cervico-medullary junction lesions, essential tremor, dystonia, and amyotrophic lateral sclerosis (1,2,4,7,8).

Case Report

Twenty-two-year-old male patient presented with involuntary contractions that were present in one hand while moving the other hand (Video 1). These complaints that were present for the last couple of years and progressing lately were preventing him to work. We found that there was no loss of consciousness and no involvement of the lower limb. And the patient had a normal neurological examination. Pre, peri, and postnatal backgrounds were normal. While being cognitively normal, the patient had slower motor development from the childhood and was also being monitored by endocrinology for hypogonadotropic hypogonadism diagnosis. While being the first of the two children, his parents had first -degree consanguineous marriage and the other child has auditory problems. On physical examination, contractions in the opposite hand were especially evident while making precise motor movements on one hand. Anosmia and hyposmia were absent in the patient. Cranial and cervical magnetic resonance imaging (MRI) were normal (Figure 1). In laboratory examination, routine tests (hemogram and biochemistry), thyroid function tests, vitamins A, E, and B12, selenium, copper, ceruloplasmin, and lead values were normal. ELISA tests (hepatitis, HIV, HbsAg, anti-Hbs, and HCV) were also negative. In electroneuromyography (EMG) while forearm's voluntary movements, EMG activities in similar muscle groups of the opposite limb were observed. Sensory and motor conduction examinations were normal. In terms of congenital and metabolic anomalies, optometrical and otolaryngological examinations were normal. In functional MRI, it was seen that contralateral cortical motor areas were activated when both, hand actively moved and the other hand contracted involuntarily (Figure 2).

Discussion

Mirror movements are mimicry of the opposite side's voluntary muscle movements, especially in the upper limb distal muscles (3). Among various movement disorders, it is not quite rare. Mirror movements can be problematic. To try to cope with this situation, patients might suppress the mirror movements by contracting the opposite side's antagonist muscles. But even so, mirror movements are disabling. Recognition of these movements is crucial for early diagnosis. Two general mechanisms are suggested for the formation of mirror movements. First: progression of the corticospinal tract of the primary motor cortex (M1) of the hand originating from the same hemisphere to the ipsilateral spinal cord without crossing. These abnormal ipsilateral pathways may be related to the diagonally branching corticospinal fibers. This is thought to be related to the dysfunction of the neural circuits that must operate contralaterally to the primary motor cortex to

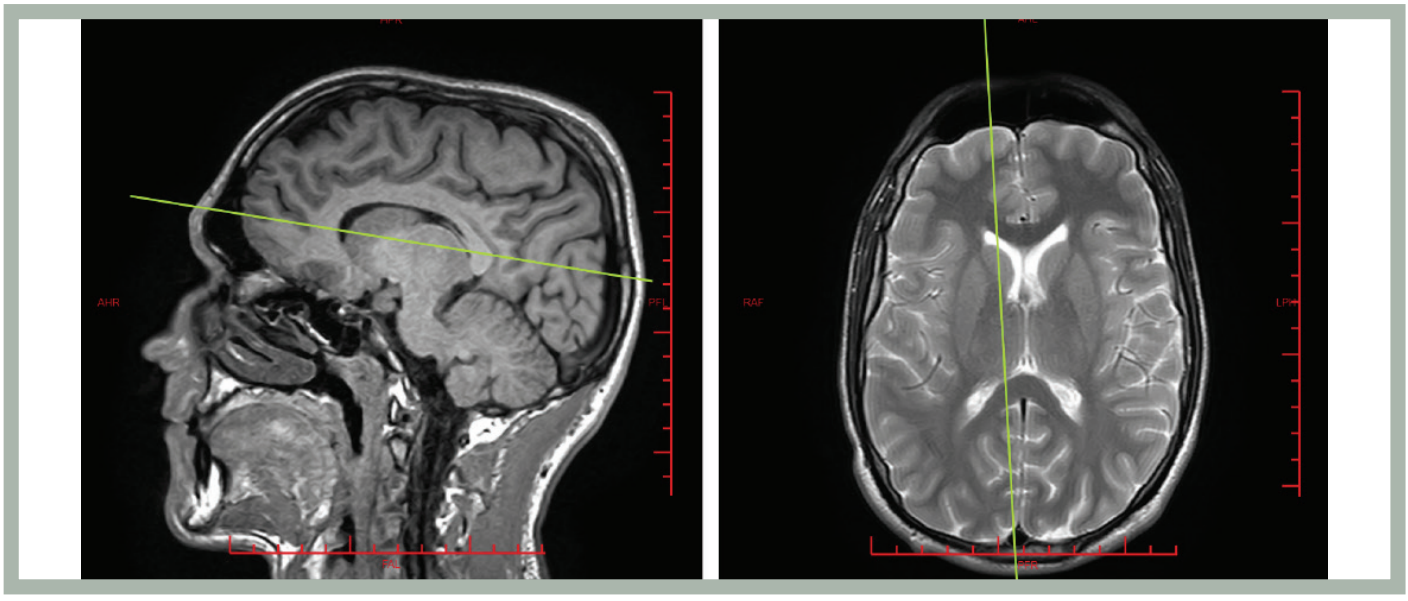

Figure 1. Cranial magnetic resonance imaging

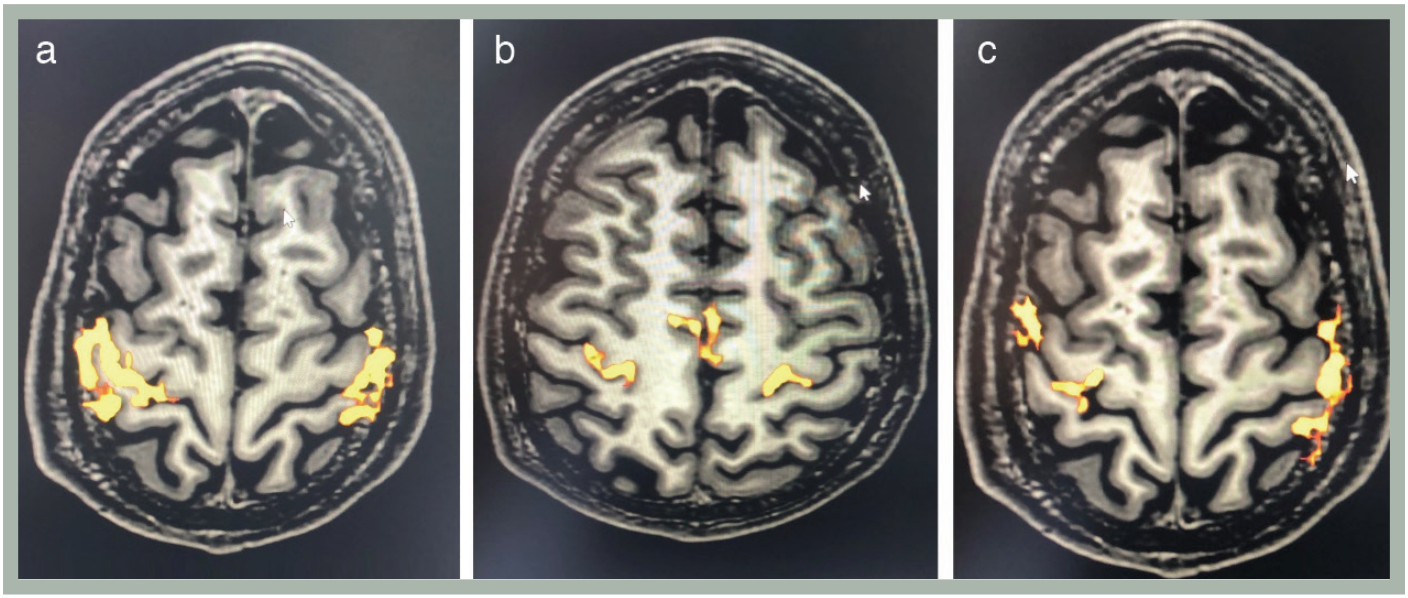

Figure 2. (a-c) In functional magnetic resonance imaging, it was seen that contralateral cortical motor areas were activated when both, hand actively moved and the other hand contracted involuntarily

which voluntary movement is dependent. Second: bilateral cortical activation due to decreased transcallosal inhibition or increased transcallosal excitation. As a result, mirror movements occur because of abnormal activation of both hemispheres of single-handed intended movements. The etiopathology of mirror movements provides clues about the congenital or acquired form of the disease (2,4).

Our case was evaluated primarily in terms of Kallmann's syndrome, due to mirror movements and the diagnosis of hypogonadotropic hypogonadism. Kallmann's syndrome is a neuronal migration disorder characterized by anosmia/hyposmia and hypogonadotropic hypogonadism. The clinical spectrum of isolated gonadotropin-releasing hormone deficiency includes various disorders, including Kallmann's syndrome, i.e., hypogonadotropic hypogonadism with anosmia, and its normosmic variation normosmic idiopathic hypogonadotropic hypogonadism, which represent the most severe aspects of the disorder (10,11). Additionally, mirror movements can also be seen. It's a rare genetic disorder that occurs in 1 in 8,000 in men and 1 in 40,000 in women (3,8,9). This syndrome also affects the olfactory system. This predicts that the development of other axonal pathways may also be affected, thus causing damage to the axonal pathways in the motor system. In cranial MRI, especially in coronal sections, the olfactory bulb may not be visible (3). The olfactory bulbus was prominent in the cranial MRI in our case. Anosmia/hiposmia was not present. In functional MRI, it was seen that cortical motor areas were activated in the contralateral of the both the hand that actively moved and the hand that contracted involuntarily.

In many studies studied on mirror movements, it has been shown that voluntary one-sided hand movement leads to bilateral motor cortex activation. Positron emission tomography, electroencephalography and simultaneous EMG, transcranial magnetic stimulation and functional MRI have been used in some studies to demonstrate this (3,10). Diffusion tensor imaging or functional MRI has recently come to the fore as neuroimaging to evaluate mirror movements. Changes in the corpus callosum volume, reduction in transcallosal motor fibers, and bilateral motor cortex activation can be seen in functional MRIs (1). We also think that when such complaints are encountered, functional MRI should primarily be kept in mind and preferred to show the etiopathology non-invasively, in a better and shorter time and to assist in the distinction between acquired and congenital forms.

Ethics

Informed Consent: Consent has been taken.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: N.T.H., V.K., A.A., M.Ç., Concept: N.T.H., V.K., A.A., M.Ç., Design: N.T.H., V.K., A.A., M.Ç., Data Collection or Processing: N.T.H., V.K., A.A., M.Ç., Analysis or Interpretation: N.T.H., V.K., A.A., M.Ç., Literature Search: N.T.H., V.K., A.A., M.Ç., Writing: N.T.H., V.K., A.A., M.Ç.

Conflict of Interest: No conflict of interest was declared by the authors.

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Video 1.

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