Ipsilateral, but via the callosum: a technical definition of handedness

The observation by Jang et al,1 confirming the activity of the ipsilateral motor cortex2 (in a presumably right-handed subject) on moving the nondominant hand, has been of interest to those concerned with human motor control for a long time. However, the underlying anatomy that Jang suggested (ie, the presence of a functioning ipsilateral motor pathway) has never been documented in humans (except as a rare anatomic anomaly) and is inconsistent with a large body of data from various disciplines, all denoting the existence of a laterality indexed central command for voluntary movements (including speech), located in the major hemisphere, driving the neuronal aggregate of its counterpart in the minor hemisphere via the callosum, by excitatory synapses.3

Clinically, this is manifested in the following 3 laterality indexed syndromes: (1) apraxia on the nondominant side in dominant hemispheric lesions; (2) hemiparesis, usually transient, after callosal sectioning, be it natural4 (eg, in Marchiafava-Bignami disease, in trauma) or iatrogenic5 (regardless of the use of a retractor during surgery); and (3) ipsilateral paresis in certain hemispheric insults (regardless of presence or absence of Kernohan's notch).6

Whereas the first item above is of common occurrence, a comprehensive review of the literature and my own unpublished data confirm the validity of the situation regarding the other 2 (less common) syndromes as sketched above. The mechanism underlying these remote effects seems to be von Monakow's interhemispheric diaschisis causing deafferentation of the otherwise normal minor hemisphere, reflected as a paresis ipsilateral to the (damaged) major hemisphere; the same mechanism operates in the better-known syndrome of frontal lobe ataxia of Bruns, engendering cerebrocerebellar diaschisis. The implications of the above-outlined anatomy in understanding (ie, technically defining) handedness and its utility in elucidating those presentations that await explanation (eg, crossed aphasia and crossed nonaphasia) are rather obvious2-9 while its therapeutic applications remain unknown. In all bilateral simultaneous exercises, the reaction time for the nondominant hand is longer by an amount equal to the interhemispheric transfer time2,8 (IHTT); similarly, any interruption of motor command, such as that induced by transcranial magnetic stimulation (TMS), will last longer on the nondominant side by an amount equal to the IHTT.9 Therein lies the technical definition of handedness, obviating the need for arbitrary inventories, a source of much ambiguity and confusion in laterality research.

In Jang's case, the absence of an expected functional magnetic resonance imaging signal on the right hemisphere when exercising the left fingers was probably related to the basic anomaly of the patient (schizencephaly). That they obtained any motor evoked potential from ipsilateral thenar muscles, and of similar amplitude (fig 3), in a 28-year-old man was also indicative of the fact that there was something amiss in this patient, because all ipsilateral TMS-induced influences are masked long before reaching that age3,10; the similarity of latency of responses in both hands is, therefore, of unknown significance.

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References


