

Brain activation on sexual orientation in female-to-male transsexuals: A functional MR imaging study

Tae-Hoon Kim¹, Seok-Kwun Kim², and Gwang-Woo Jeong^{1,3}

¹Research Institute of Medical Imaging, Chonnam National University Medical School, Gwangju, Korea, Republic of, ²Plastic and Reconstructive Surgery, Dong-A University Hospital, Busan, Korea, Republic of, ³Radiology, Chonnam National University Medical School, Gwangju, Korea, Republic of

Synopsis: Present inferences postulate that the perception of the own sex is linked to sexual differentiation of the brain and that perception in transsexuals differs from the body phenotype. Such a discrepancy is believed to be possible because sex differentiation of the brain occurs later in development than sex differentiation of genitals. Therefore, this implies that neuroanatomy plays an important role in determining transsexualism or gender identity. Recently, Gizewski *et al.* reported that male-to-female (MtF) transsexuals showed specific cerebral activation in response to visual erotic stimuli, indicating a tendency of female-like cerebral processing in transsexualism. However, female-to-male (FtM) transsexuals are little known. Therefore, this study was to evaluate the brain activation in response to visual erotic stimuli for cross-gender identity in FtM transsexuals by using fMRI.

Subjects and Methods: A total of 12 FtM transsexuals (mean age: 43.8; age range 36-54 years), who have had sex-reassignment surgery to alter their natal bodies with the gender identity disorder at the Dong-A University Hospital (Busan, Republic of Korea), were recruited in this study.

The subjects were studied on a 3T MRI scanner (Siemens Magnetom Tim Trio, Germany) with a 12-channel head coil. Functional MR images were acquired using a gradient-echo echo planar imaging (GRE-EPI) pulse sequence with the following parameters: TR/TE= 2000/30 ms, flip angle= 90°, FOV= 22×22 cm², matrix size = 64×64, NEX= 1, and slice thickness= 4 mm. Visual stimulation paradigm consisted of rest with natural documentary pictures, emotionally neutral pictures, female (innate same sex) erotic pictures and male (their desired sex) erotic pictures as follows: Rest(30sec) – Neutral(1min) – Rest(30sec) – Female(1min) – Rest(30sec) – Male(1min) – Rest(30sec). Brain activation was analyzed by the statistical parametric mapping program (SPM2).

Results and Discussion: During viewing female pictures, predominant brain activation was showed in the regions of the superior frontal gyrus, supplementary motor area, anterior/median cingulate gyri and hypothalamus, whereas during viewing male pictures, brain activation was prominent in the regions of the middle/inferior frontal gyri, precentral gyrus, middle temporal gyrus, fusiform gyrus, superior/middle occipital gyri, cerebellar cortex and vermis ($p < 0.001$).

Interesting activation areas were the cingulate gyrus and hypothalamus because anterior and median parts of the cingulate gyrus belonging to the limbic system are involved in emotional formation and processing, and have been closely associated with sexual response such as sexual attraction, drive and arousal.

Table 1. Dominant brain activation areas in female-to-male transsexuals during viewing female and male erotic pictures compared to emotionally neutral pictures

Anatomical area	Abbr.	Female over Neutral (uncorrected $p < 0.001$)			Male over Neutral (uncorrected $p < 0.001$)		
		Activity (%)	t-value	MNI coordinate	Activity (%)	t-value	MNI coordinate
		x	y	z	x	y	z
<i>Common regions</i>							
Inferior temporal gyrus	ITG	2.9	4.72	48	-56	-14	
Superior parietal lobe	SPG	11.5	5.73	-33	-44	44	
Inferior parietal lobe	IPG	16.5	5.48	-36	-45	46	
Supramarginal gyrus	SMG	14.8	5.81	64	-18	32	
Postcentral gyrus	PoG	3.7	5.69	64	-18	37	
Inferior occipital gyrus	IOG	2.0	4.52	46	-59	-11	
<i>Differential regions</i>							
Superior frontal gyrus	SFG	2.3	4.99	4	58	19	
Middle frontal gyrus	MFG						
Inferior frontal gyrus	IFG						
Supplementary motor area	MoS	2.3	4.59	0	26	40	
Precentral gyrus	PrG						
Middle temporal gyrus	MTG						
Fusiform gyrus	FuG						
Superior occipital gyrus	SOG						
Middle occipital gyrus	MOG						
Anterior cingulate gyrus	ACgG	3.5	4.26	-8	23	26	
Median cingulate gyrus	MCgG	0.9	4.44	-1	26	37	
Hypothalamus	Hy	12.0	5.00	6	0	-12	
Cerebellar cortex	Cb						
Vermis	Verm						

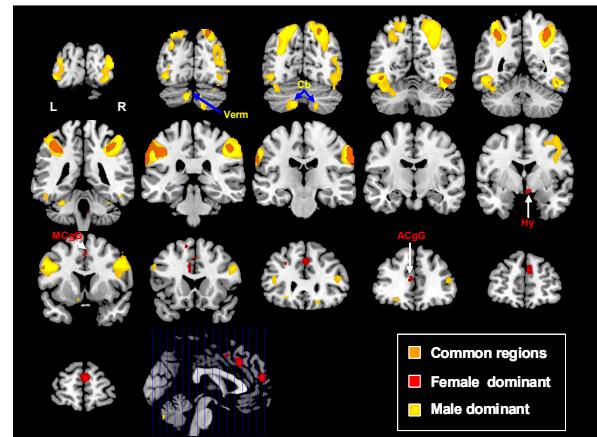


Fig. 1. Coronal sectional images overlaying dominant brain activation maps obtained from the contrasts of “Female vs. Neutral” and “Male vs. Neutral”

Moreover, the hypothalamus organizes and controls many complex emotions, feelings and moods with the concept of pleasure including satisfaction, comfort and creative activities, and releases hypothalamic neurotransmitters which relay information and instruction to all parts of the brain and body.

Therefore, those activations in FtM transsexuals were revealed specific activation pattern reflected for their sexually-preferred gender during viewing female erotic pictures. Whereas during viewing male pictures, the neocortex regions showed enhanced activation for functioning higher cognition with visio-spatial processing, and especially the cerebellar cortex related to unconscious processing, and the vermis involved in the induction of genital erection were dominant.

Conclusions: This finding revealed remarkable activation pattern reflected for sexually-preferred gender identity in FtM transsexuals, however its activations still remained sexual orientation with biological innate sex. Therefore, this study would be helpful to understand the underlying mechanisms that contribute to the development of gender identity or transsexualism in relation to functional neuroimaging.

* This work was supported by the National Research Foundation of Korea (NRF) (No. 2011-003088).

References

1. Sanchez FJ, Vilain E. *J Couns Psychol* 2009; 56:202-209.

2. Cohen-Kettenis PT, Gooren LJ. *J Psychosom Res* 1999; 46:315-333.