Brain activation study by passive intra-articular movement of radiolunate and sacroiliac joints using fMRI.

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[Introduction]

Arthrokinematic approach (AKA) is well known as relief of joint pain and treatment of joint contracture and/or rehabilitation method of extremity. Joint mobilization therapy has been performed in practice for a long time [1, 2]. Nevertheless, we still haven't made effectiveness of these methods clear. In this study, we studied to clarify the effect of passive intra-articular movement to the brain using fMRI. We used an AKA-Hakata method, which is improving in Japan to treat for joint pain and disability [3]. This is a very fine manipulation method for joint dysfunction, arthritis of sacroiliac joint and so on, which often causes severe pain, referred pain and motion pain. This technique is not so easy, because a careless handling of the joint induces arthokinetic and arthrostatic reflex, which increases muscle tonus surrounding the joint, and so one could not manipulate the joint with hand therapy of intra-articular movement. Therefore, in this study, joint manipulation has been performed by one of the most skillful manual therapist in Japan.

[Materials and Methods]

Nine healthy subjects (8 males and 1 female, age 20-38 years) participated in this study. All participants received tactile stimulation for control sensory stimulation, which is scrubbing the skin at the left palm by sponge, and also received passive joints movement stimulation. Stimulation of joint movement consisted of three kinds of stimulations – passive joint movement of wrist for control movement stimulation, passive intra-articular movement of left radiolunate joint (one of the radiocarpal joints), and left sacroiliac joint, which was performed pulling the left iliac crest toward the caudal side. The block design consisted of 30 s resting state following 5 times [30 s stimulations (on) - 30 s resting scans (off)]. All experiments were performed on a Siemens 3 T Trio MRI system with a standard head coil. Subjects underwent GE-EPI scans, each made up of 130 temporal dynamics, with each dynamic consisting of 35 axial slices (3 mm thickness; matrix 64x64, FOV 23x23 cm^2; TR 2000 ms; TE 30 ms). Intra-articular movement of the joint was performed 9 times during 30 s stimulation period and the therapist touched the subject on the joint same position as AKA handling in the rest period. The fMRI data were analyzed using SPM 8. The threshold of the data was at $p< 0.05$.

[Results & discussion]

Passive bending and stretching exercise of left wrist joint elicited higher activation in ipsilateral cerebellum and BA13 (Brodmann area 13), contralateral thalamus, putamen, BA4, 6, 13, 22, 24, and 40 (Fig. 3). The stimulation by passive intra-articular movement of left radiolunate joint elicited higher activation in contra-lateral thalamus, BA4, 10, 13, 22, and also ipsilateral cerebellum and BA40 (Fig. 1). The stimulation by passive intra-articular movement of sacroiliac joint elicited higher activation in contra-lateral BA6, 13, and ipsilateral BA7, which was a part of somatosensory association cortex (Fig. 2). Although, in the radiolunate joint, intra-articular sliding movement by AKA manipulation is only within 3 mm in distance, brain activation with this fine movement could be detected using fMRI. Therefore, joint pain may be modified by manipulation of intra-articular movement. Characteristic brain activation by sacroiliac intra-articular movement stimulation was observed in contralateral parietal cortex, BA7. A recent study of resting fMRI observed decreased connectivity in parietal cortex with pain stimulation [4]. Nevertheless, it is difficult to eliminate the sensory contamination of pelvic tissues due to pull an upper-anterior crest of iliac bone in brain activation, and we need further study in detail. This is a first basic study of manual therapy using fMRI.

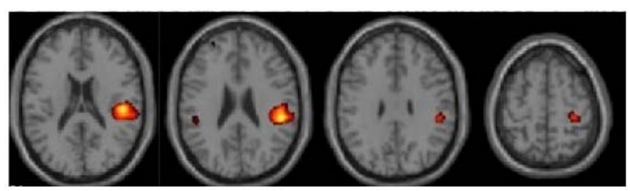

Fig. 1 fMRI: passive intra-articular movement of left radiolunate joint

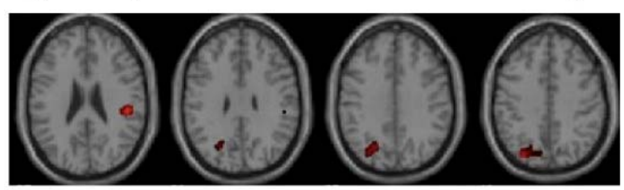

Fig. 2 fMRI: passive intra-articular movement of left sacroiliac joint

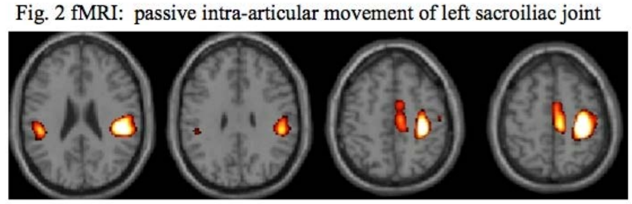

Fig.3 fMRI: passive movement of lt. wrist joint

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