

## Short Communication

## Establishment of a safe acupuncture method for the psoas and iliopsoas muscles using ultrasound imaging equipment

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### Abstract

The iliopsoas muscle is composed of the psoas major and iliacus muscles. There are currently no objective method regarding the safe angles and insertion depths of acupuncture needles for these muscles. This study aimed to investigate the safe insertion points of acupuncture needles into the psoas major and iliacus muscles using ultrasound imaging equipment.

Sixteen healthy male volunteers participated in this study. An ultrasound system (LOGIQ-e, GE, USA) and a linear probe (GE, USA) were used. Acupuncture needles measuring 60 mm were used for the psoas major muscle and 50 mm for the iliacus muscle. The distance, depth, and angle of the needles were measured at the point where muscle contraction was obtained using an electro acupuncture stimulator (Picorina<sup>®</sup>, SEIRIN Co., Japan).

The insertion point for the psoas major muscle was  $4.5 \pm 1.8$  cm below the anterior superior iliac spine,  $2.9 \pm 1.3$  cm lateral to the femoral artery,  $78 \pm 14^\circ$  vertically and  $51 \pm 10^\circ$  horizontally from this point,  $4.7 \pm 0.4$  cm deep, and the needle was confirmed to be oblique medially. On the other hand, the iliacus muscle acupuncture point was located  $2.2 \pm 0.4$  cm medial to the anterior superior iliac spine, from which acupuncture was performed at  $64 \pm 18^\circ$  vertically,  $58 \pm 9^\circ$  horizontally, and  $3.2 \pm 0.6$  cm deep. In all subjects, we could confirm that the psoas major muscle moved in conjunction with the contraction of the iliacus muscle due to electro-acupuncture stimulation.

It was suggested that the above method could be safely applied to people whose age, body size, and sex are similar to those of the subjects in this study.

Additionally, ultrasound images confirmed that electrical stimulation of the iliacus muscle induced contraction of the psoas major muscle, suggesting that indirect contraction of the iliopsoas muscle, including the psoas major, by electroacupuncture to the iliacus muscle may be utilized as a treatment for low back pain.

**Key words:** psoas major, iliacus muscles, ultrasound imaging equipment, electro-acupuncture

### I. Introduction

The iliopsoas muscle is a large compound muscle composed of the psoas major muscle (PM) and iliacus muscle (IM). Previous studies have shown that patients with low back pain (LBP) have an increased lumbar kyphosis angle due to the shortening of the iliopsoas muscle<sup>1)</sup>. Therefore, the iliopsoas muscle is one of the muscles that can cause LBP and can be a targeted muscle for acupuncture treatment.

Cummings<sup>2)</sup> reported that an acupuncture insertion point on the iliopsoas muscle is located approximately 2-3 cm lateral to the femoral artery in the groin. Ball et al<sup>3)</sup> also showed that the needle could be applied to the iliopsoas muscle between  $32.1 \pm 7.3$  mm medial to the anterior inferior iliac spine in the supine position. However, there are no objective methods for a safe angle or penetration

depth for these points. This study aimed to investigate the safe acupuncture insertion points for the PM and IM using an ultrasound imaging system.

### II. Methods

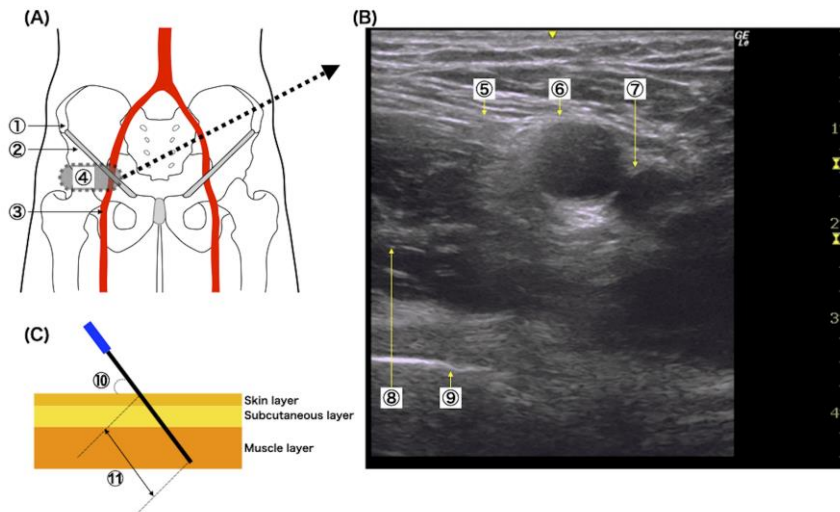
Sixteen male adults (mean $\pm$ SD age;  $23 \pm 1$  years, height;  $171 \pm 7$  cm, weight;  $70 \pm 9$  kg, BMI;  $24 \pm 3$ ) participated in this study. Those with a history of hip or gastrointestinal disease were excluded from this study. The experiment was conducted after written consent was obtained from the subjects following a full explanation of the protocol. This study was approved by the Research Ethics Review Committee of the Academic Research Council of Tokyo Ariake University of Medicine. (Approval number: 295) It has also been registered in the UMIN Clinical Trials

Registry (UMIN-CTR), a UMIN clinical registry system (UMIN study ID: UMIN000046826).

A diagnostic ultrasound system (LOGIQ-e, GE, USA) and a linear probe were used. The imaging conditions of the ultrasound were: B mode, frequency 8 MHz, depth 4.5 cm, and focus 1.5 cm to 2 cm. Moving ultrasound images of the PM and IM were also recorded. Linear probes were placed on the pulsating femoral artery and the anterior superior iliac spine (ASIS). Single-use stainless steel acupuncture needles (SEIRIN Co., Japan) with a diameter of 0.20 mm were used; 60 mm needles were used for PM, and 50 mm needles were used for IM. Using the ultrasound, the PM, femoral arteriovenous vein, and nerves were visualized in the inguinal region, and the IM, peritoneum, and intestinal tract in the abdomen were visualized to confirm the positional relationship between these muscles and surrounding tissues. Based on these images, acupuncture needles were inserted and energized. After confirming presence of muscle contraction with ultrasound, the distance, depth, and angle of the needles were measured. Differentiation between the PM and IM was determined by the running of muscle fibers during contraction and was performed at the stimulus intensity where painless muscle contraction was obtained with an upper limit of 4 mA output from the electroacupuncture stimulator (Picorina<sup>®</sup>, SEIRIN Co., Japan).

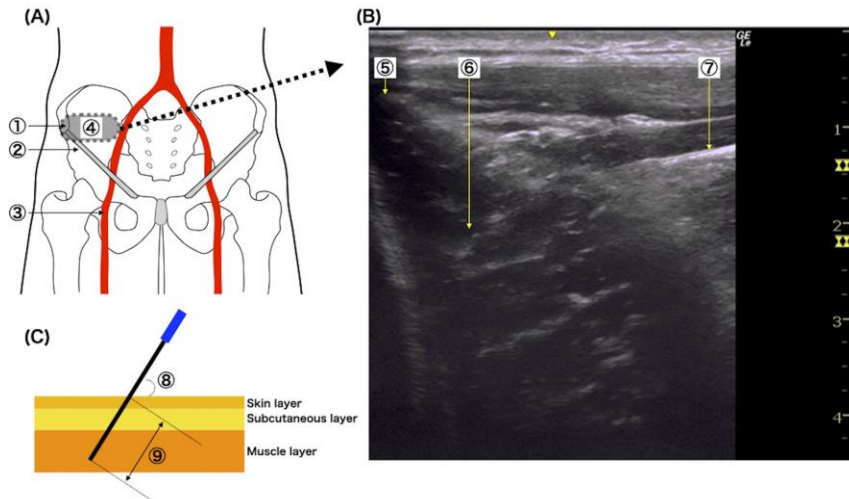
### III. Results

Representative images of the PM and IM obtained using the ultrasound recording system are shown in Figures 1 and 2, respectively. Using these images as a reference, we were able to confirm muscle contraction of the PM under the following conditions: the insertion point was located  $4.5 \pm 1.8$  cm below the ASIS and  $2.9 \pm 1.3$  cm laterally from the femoral artery. The conditions for acupuncture were  $78 \pm 14^\circ$  vertically and  $51 \pm 10^\circ$  horizontally from that point, and  $4.7 \pm 0.4$  cm of the needles should be inserted obliquely and facing medially. On the other hand, the acupuncture insertion point for the IM was located  $2.2 \pm 0.4$  cm medially from the ASIS, and the conditions for acupuncture were  $64 \pm 18^\circ$  vertically and  $58 \pm 9^\circ$  horizontally from that point, and  $3.2 \pm 0.6$  cm depth. Notably, we could confirm that in all subjects, the PM moved in conjunction with the contraction of the IM caused by electroacupuncture stimulation. As an adverse event, transient radiating pain to the area innervated by the lateral femoral cutaneous nerve occurred in 3 cases during iliopsoas muscle acupuncture, but this symptom resolved immediately.



**Figure 1** Acupuncture insertion point for the psoas major muscle (PM).

Figure 1-(A) shows a schematic diagram of the ultrasound image measurement. The gray dashed line indicates the probe position. Typical ultrasound image of the upper right inguinal region (B). The muscle contraction of the PM is obtained by acupuncture insert point of ④, which is located  $4.5 \pm 1.8$  cm below the ASIS and  $2.9 \pm 1.3$  cm laterally from the femoral artery, at a  $51 \pm 10$  deg angle ⑩ and a  $4.7 \pm 0.4$  cm depth ⑪. Data are shown as mean  $\pm$  standard deviation. ①: ASIS: anterior superior iliac spine, ②: inguinal ligament, ③ and ⑥: femoral arteria, ⑤: femoral nerve, ⑦: femoral vein  
⑧: psoas major muscle, ⑨: femoral head.



**Figure.2** Acupuncture insertion points for the iliocostalis muscle (IM).

Figure 2-(A) shows a schematic diagram of the ultrasound image measurement. The gray dashed line indicates the probe position. Typical ultrasound image of the right anterior superior iliac spine (B). The muscle contraction of the IM is obtained by acupuncture insert point of (A)-○d, which is located  $2.2 \pm 0.4$  cm medially from the ASIS, at a  $58 \pm 9$  deg angle (8) and a  $3.2 \pm 0.6$  cm depth (7). Data are shown as mean  $\pm$  standard deviation. ① and ④: ASIS: anterior superior iliac spine, ②: inguinal ligament, ③: femoral artery, ⑤: iliopsoas muscle, ⑥: peritoneum, ⑦: iliocostalis muscle, ⑧: iliopsoas major muscle, ⑨: femoral head.

#### IV. Conclusion

In this study, we identified stimulation points on the PM and IM using ultrasound. Although electrical stimulation may induce muscle contraction even if the acupuncture needles do not reach the target muscles, we were able to establish the points at which acupuncture stimulation can elicit contraction in these muscles. Since there were no female subjects or extreme outliers in terms of BMI, it is unclear whether the same method can be applied to all patients. Therefore, we suggest that the above method can be safely applied to people of similar age, body size, and sex as the subjects in this study. However, transient radiating pain to the lateral femoral cutaneous nerve may occur during acupuncture of the iliopsoas muscle, in which case, the needle should be reinserted.

The following points should be noted when acupuncture needles are inserted into the PM and IM: for PM, needles should be inserted obliquely from the femoral artery to the medial side to avoid the femoral artery and femoral nerve; for IM, needles should be inserted obliquely from 2 cm medial to lateral (toward the iliac crest) from the superior anterior iliac spine to avoid the peritoneum while capturing the muscle belly. To insert the needles into the muscles, the length of the needles should be 60 mm for PM and 50 mm for IM. The method presented here avoids the risk of needling internal organs, blood vessels, and femoral nerves.

Finally, the needle insertion location of the PM was close to the perineum, which may have caused most patients to refuse treatment. The insertion points of the IM located at the ASIS are relatively more acceptable, and ultrasound imaging confirmed that electrical stimulation of the IM induces muscle contraction of the PM, and indirect contraction of the PM by electroacupuncture of the IM could be used as a treatment for back pain.

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