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CASE REPORT

Ultrasonography in Acupuncture—Uses in Education and Research

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Abstract
This study aims to explore the potential use of ultrasound in locating the second posterior sacral foramen acupuncture point, quantifying depth of insertion and describing surrounding anatomical structures. We performed acupuncture needle insertion on a study team member. There were four steps in our experiment. First, the acupuncturist located the acupuncture point by palpation. Second, we used an ultrasound machine to visualize the structures surrounding the location of the acupuncture point and measure the depth required for needle insertion. Third, the acupuncturist inserted the acupuncture needle into the acupuncture point at an angle of 30°. Fourth, we performed another ultrasound scan to ensure that the needle was in the desired location. Results suggested that ultrasound could be used to locate the acupuncture point and estimate the depth of needle insertion. The needle was inserted to a depth of 4.0 cm to reach the surface of the sacral foramen. Based on Pythagoras theorem, taking a needle insertion angle of 30° and a needle insertion depth of 4.0 cm, the estimated perpendicular depth is 1.8 cm. An ultrasound scan corroborated the depth of 1.85 cm. The use of an ultrasound-guided technique for needle insertion in acupuncture practice could help standardize the treatment. Clinicians

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and students would be able to visualize and measure the depth of the sacral foramen acupuncture point, to guide the depth of needle insertion. This methodological guide could also be used to create a standard treatment protocol for research. A similar mathematical guide could also be created for other acupuncture points in future.

1. Introduction

In acupuncture treatment, sufficient needling depth is required to ensure adequate degree of somatosensory stimulation for treatment efficacy [1], yet safe needling depth is a concern [2,3]. However, needling is based on blind insertion. Hence, acupuncturists face two challenges in delivering needle insertion: location and depth of needle insertion.

Location of an acupuncture point is based on palpation, and deep acupuncture points could be difficult to palpate. Reaching the desired needle depth is mainly based on the patient's self-report of having felt dullness, tightness, soreness, tingling, aching, or electrical sensation either around the needle or traveling up or down the affected meridian, also known as the *de qi* sensation. The sole reliance on *de qi* to justify treatment efficacy is insufficient due to patients' subjectivity and the manipulation of the needle, which could produce a "fishing" sensation being misinterpreted as *de qi*. Such a sensation could also be stimulated by other factors such as anxiety during treatment.

Although standard guides have been developed to provide ranges for depth of needle insertion, the ranges can differ by a significant percentage. For example, in the acupuncture point at the second sacral foramen BL 32, the recommended depth of needle insertion ranges from 1 cun to 1.5 cun [4], representing a difference of up to 1.5 times. In addition, in acupuncture points that require deep insertion such as those in the sacral foramen, ensuring sufficient depth has been a challenge [5].

In Western medicine, ultrasound has been used to assist in clinical procedures such as biopsy [6] and peripheral nerve blocks [7]. In acupuncture, ultrasound can be a useful tool to create a scientific method of quantifying acupuncture depth and the location of anatomical structures. A review of the literature revealed that only two studies have explored the potential use of ultrasound in acupuncture [8,9]. Konofagou and Langevin [8] used ultrasound to assess the magnitude of soft-tissue displacement from the movement of needle (needle manipulation and rotation). In our previous study on a cadaveric hand, we could see the position of the needle as an echogenic spot in relation to muscle and bone [9]. Ultrasound has also been used to measure the physiological changes in blood vessel size, blood flow velocity and volume, and muscle strain before and after acupuncture needle insertion [10].

Besides ultrasound, computer tomography (CT) and magnetic resonance imaging (MRI) of human bodies have also been used to study the tradition Chinese meridian [11,12]. CT and MRI have been found to be useful for reconstructing the body fasciology and studying in relationship with the meridians [11]. A pattern of line-like structures that appear similar in form and distribution to the meridians has been observed [12]. Although MRI and CT are other cross-sectional imaging modalities that can potentially be used to guide needle insertion, these modalities have their limitations. MRI is a costly modality and not widely available. The ionizing radiation involved in a CT scan is a concern. Ultrasound is nonionizing, cost effective, and widely available and can provide real-time images. Hence, ultrasound is a better alternative modality to MRI or CT scans in locating the anatomical structure. In the present study, we aimed to explore the potential use of ultrasound in quantifying depth of insertion and surrounding anatomical structures, using a case example of an acupuncture point at the second posterior sacral foramen.

2. Materials and methods

2.1. Acupuncture needle insertion

We performed the acupuncture needle insertion on a study team member. The team member signed an institutional informed consent form about knowing the procedure involved in acupuncture, and the possible risks and complications. The acupuncture was performed by a certified acupuncturist. The acupuncture point used in this study was BL 32 (Ci Liao), located at the second sacral foramen. The sacral foramen has three acupoints—BL 31, BL 32, and BL 33. However, we have empirically chosen BL 32 as it is the middle point, and we were able to confirm the point by referencing it to BL 31 and BL 33. The participant was laid prone. A sterile technique was used—the site of needle insertion was cleansed using alcohol swab prior to needle insertion. The needle was directed superiorly at a 30° angle, using a 0.30×50 mm^2 disposable stainless-steel acupuncture needle. The needle was inserted at a 30° angle to enable visualization of the needle tip on ultrasound. This is a limitation of ultrasound. In addition, after visualizing the sacral foramen, an angle of 30° was used to best reach the opening due to the pelvic tilt of the participant.

2.2. Ultrasound scan

Ultrasound scans were conducted using a Philips iu22 system (Philips Healthcare, Bothell, WA, USA) with a 12—5 MHz linear probe at the Department of Diagnostic Radiology. A board-certified sonographer performed the scans. Aquasonic 100 was used as the coupling gel.

2.3. Experimental steps

There were four steps in our experiment.

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