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Original Article

Development of an ultrasound-imaging procedure and acquisition of ultrasound images of acupuncture points for safety and accuracy of needle insertion

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ABSTRACT

Background: Acupuncture is a relatively safe, commonly used "alternative" medical treatment for various symptoms. However, adverse effects can occur, including trauma, pneumothorax, and central-nervous-system injury. Our objective was to develop a reliable and practical procedure for ultrasound imaging of acupuncture points to improve safety during needling, and to acquire ultrasound images of several (44) acupuncture points, especially those in high-risk areas, according to an in-house standard operating procedure.

Methods: We created the standard operating procedure for ultrasound imaging for acupuncture, and collected ultrasound images of acupuncture points in clinical trials.

Results: We collected ultrasound images for 44 acupuncture points considered as high-risk points from 85 healthy people who were classified by body-mass index, and obtained high-quality, clear representative images of all 44 points.

Conclusion: These baseline images could be helpful for understanding the anatomy under the skin at acupuncture points, which would allow for an enhanced safety and more accurate needling.

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1. Introduction

Acupuncture is a relatively safe, commonly used "alternative" medical treatment for various symptoms. However, there are locations where the needle is next to vulnerable structures, such as internal organs, nerves, and pleural membranes[1]; needling at these locations can induce adverse effects, including trauma, hemorrhage, pneumothorax, and central-nervous-system injury.[2–5]

Preventing these side effects is a key concern while performing acupuncture. For dry needling or injection, similar to acupuncture, ultrasound guidance has been used for preventing soft-tissue injury.[6] To address this concern, there is a growing interest in visualization of the anatomy under the skin at acupuncture points. A survey for Korean medicine doctors (KMDs) found that more than 12% of doctors believe there is a need for visualization of acupuncture points.[7]

Previous studies have used magnetic resonance imaging[8–12] and computed tomography[2,9,13,14] imaging to identify safe depths or angles when needling. However, these imaging modalities are expensive, and in the case of computed tomography, radiographic exposure is required. Ultrasound has been regarded as a safe and convenient method,[15,16] and is suitable for analyzing acupuncture points on the limbs[2] and for live monitoring during the acupuncture procedure.

Ultrasound has been used in several studies to analyze acupuncture points. The primary analyses in these studies included measures of insertion depth or distance from the needle tip to the tissue, including nerve and facet joints, and confirmation of the needle tip for guidance purposes.[1,17–20] However, these have been limited to only a few acupuncture points and to only one cross section. Furthermore, the criterion of a standard operating procedure (SOP), including the angle of probe, to detect specific acupuncture points using ultrasound was not considered in these studies. Therefore, the present study was conducted to develop a reliable and practical procedure for ultrasound imaging of acupuncture points, and to acquire ultrasound images of several (44) acupuncture points, especially those in high-risk areas, according to an in-house SOP.

2. Methods

The workflow is described specifically in Fig. 1. It contained the following specific steps: (1) development of an SOP; (2) clinical trials; and (3) determination of representative images.

2.1. SOP development

The SOP was developed with experts in diagnostics (The Society of Korean Medicine Diagnostics and The Korean Medical Visceral Shape for Sonography Institution), clinical science (Korea Pharmacopuncture Institute, Korean Acupuncture and Moxibustion Medicine Society, and The Society of Korean Medicine Rehabilitation), and basic medical sciences (Society for Meridian and Acupoint, Korea Standards Research Institute, and Korean Medicine Standards Center at the Korea Institute of Oriental Medicine) based on the books *Acupuncture Anatomy: Regional Micro-Anatomy and Systemic Acupuncture Networks*,[21] *Details of Meridians & Acupoints: A Guidebook for College Students*,[22] *WHO Standard Acupuncture Point Locations in the Western Pacific Region*,[23] and the *Acupuncture Acupoints Book of General: Code of Chinese Acupuncture Points Research*.[24] The experts specified the requirements for SOP, and collectively decided which acupuncture points should be chosen for ultrasound imaging. Guidelines for the direction of the probe when imaging via ultrasound were also developed.

2.2. Clinical trials

One-arm clinical trials were conducted to acquire ultrasound images of 44 (in total) acupuncture points. The trials were approved by the Ethics Committee of the Wonkwang University Hospital (WKIRB-201510-BM-001 and WKIRB-201606-SB-033). All volunteers provided written informed consent prior to the study participation. The participants were recruited at Wonkwang University Hospital, first from October 2015 through February 2016, and then from June through December 2016. In all, 85 healthy participants [males ($N = 40$) and females ($N = 45$); body-mass index (BMI in kg/m^2) < 18.5 ($N = 14$), BMI ≥ 18.5 and <25 ($N = 48$), BMI ≥ 25 ($N = 24$)] were recruited; the ages were between 19 and 39 years.

A participant was included if (1) his/her age was between 19 and 39 years old; and (2) he/she agreed to participate and

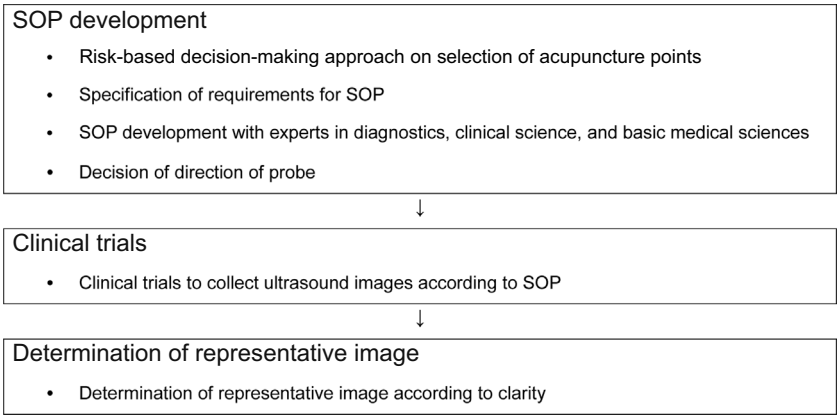

Fig. 1 – Overview of the study process. **SOP, standard operating procedure.**

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