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● *Original Contribution*

QUANTITATIVE ULTRASOUND ASSESSMENT OF THE FACET JOINT IN THE LUMBAR SPINE: A FEASIBILITY STUDY

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Abstract—This study was designed to determine the feasibility and accuracy of a sonographic approach to assessment of facet joints of the lumbar spine in healthy populations. Five facet joints (L1–S1) on each side of 30 volunteers, for a total of 300 facet joints, were examined and evaluated by sonography and computed tomography. Parameters of the facet joints (height and width) were established to assess the facet joint in the parasagittal and transverse planes on all volunteers. Differences between means of continuous variables including age, height, weight, body surface area, body mass index and joint parameters were evaluated with Student's *t*-test. Stepwise multiple regression analysis was used to evaluate the associations between the mean values of facet joint parameters and age, height, body surface area and body mass index. In general, sonography revealed that facet joints had a clear and smooth border. There were no significant differences in width and height between the left and right facet joints at the same level by sonography. Stepwise multiple regression analysis revealed that body mass index and age ($p < 0.05$) were the only independent factors modulating height of the facet joint. Facet joint width was independently influenced by age ($p < 0.01$). There were no significant differences between ultrasound and computed tomography in mean measurements of height (1.23 ± 0.15 vs. 1.25 ± 0.07, $p > 0.05$) and width (0.17 ± 0.08 vs. 0.18 ± 0.07, $p > 0.05$) of the facet joint, respectively. In this article, we describe a feasible, accurate and simple technique for identification and depiction of facet joints of the lumbar spine in healthy populations. (E-mail: huangying712@163.com) © 2015 World Federation for Ultrasound in Medicine & Biology.

Key Words: **Computed tomography, Facet joint, Lumbar spine, Ultrasound.**

INTRODUCTION

Facet joint-mediated pain in the lumbar spine has been identified as a common cause of low back pain, including instability and osteoarthritis of the lumbar spine (Galiano et al. 2005a). Most individuals who have experienced low back pain tend to undergo computed tomography (CT) and magnetic resonance imaging examinations.

Computed tomography allows for more precise visualized resolution of the facet joints scanned in three dimensions (coronal, parasagittal and axial views of the lumbar spine). Thus, facet joints (including the facet joint space, articular process and even degenerative osteophyte formation) can be imaged more accurately by CT (Galiano et al. 2007a, 2007b). However, poor correlations between symptoms and findings, including instability and degeneration of the lumbar spine, on imaging tests lead to both overuse and inappropriate use of diagnostic resources and, thus, to increased costs and an elevated risk of complications (Galiano et al. 2007a, 2007b).

Ultrasound (US) has been proven at least sufficiently tolerable, reliable and accurate in the visualization of lumbar paravertebral anatomy to guide lumbar facet nerve block injections (Galiano et al. 2005a, 2005b, 2006, 2007a, 2007b). However, detailed knowledge of facet joint imaging characteristics of the lumbar spine for healthy populations is lacking. The morphology of facet joint degenerative diseases includes osteophyte formation, rough bone surfaces, narrow joint spaces and hypertrophy of articular processes (Boden et al. 1996; Dai and Jia 1996). Because the width and height of the facet joint indicate the extent of cartilage damage and hypertrophy of the articular process, we thought these

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two parameters could be used to predict and evaluate the stenosis and degenerative status of facet joints in the lumbar spine of patients with osteoarthritis. Normal facet joint imaging could improve our understanding of the pathologic process and its relation to lumbar spine lesions in back disorders.

This study was designed to determine the feasibility and accuracy of a sonographic approach, as compared with CT measurements, to the assessment of facet joints of the lumbar spine in healthy populations.

METHODS

Study population

Volunteers were randomly sampled from the outpatient population treated in our hospital. None of the volunteers had low back pain or pain of the lower limbs. None had received prior pharmacologic treatment for osteoporosis; experienced spontaneous improvement of infections, tumors or congenital anomalies of the lumbar spine; or undergone previous surgery on the lumbar spine. In addition, none of the volunteers was older than 40 y.

Ultimately, 33 volunteers met all the inclusion criteria and agreed to participate in the study. Age, height and weight were recorded for each study participant, and body surface area (BSA) and body mass index (BMI) were calculated. The study was conducted with approval from the local institutional review board and an informed consent statement was signed by each participant in our study.

Ultrasound measurements

Two sonographers experienced in musculoskeletal ultrasound (US) used posterior approaches to the facet joints in the lumbar spine in 33 prepared volunteers. For imaging analysis, examinations were performed with a standard US device (LOGIQ 9, GE Healthcare, Zipf, Austria) equipped with a broadband curved array transducer working at 2.8–4.0 MHz and a broadband linear array transducer working at 11–15 MHz. Imaging errors could be kept to a minimum by using the linear array probe for measurements.

The volunteers were placed in the prone position, and sonography was performed bilaterally at the level of the L1–S1 vertebrae (Fig. 1a). The transducer was positioned on the back to visualize the spinous process in the midsagittal (Fig. 1b) section. From the midline position, the transducer was moved laterally in a paravertebral parasagittal orientation toward the transition from the vertebral arch to the facet joints (Fig. 1c). There was a hypo-echogenic layer between the superior and inferior articular processes, which were hyper-echogenic on the

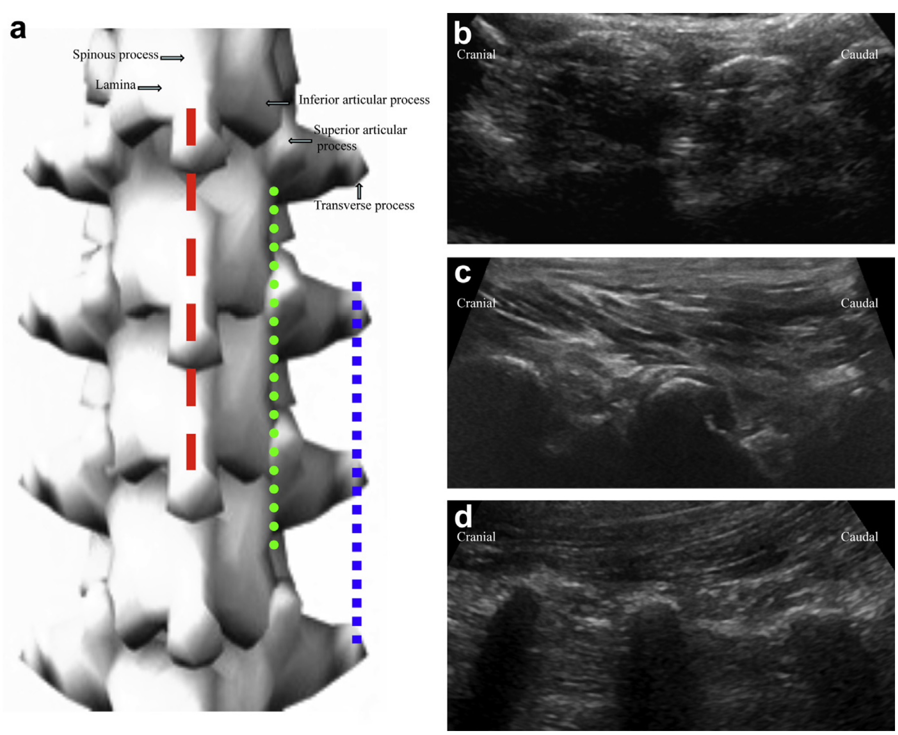

Fig. 1. (a) Schematic of the facet joint in the sagittal plane. The *red dashed line* represents the mid-sagittal line; the *green dashed line*, the parasagittal line; and the *blue dashed line*, the transverse process line. (b) Posterior sagittal plane sonogram in an exact midline of the spinous processes (L1–S1). (c) Posterior sagittal paravertebral plane sonogram of the facet joints at the L1–S1 levels. (d) Posterior sagittal paravertebral plane sonogram of the transverse processes at the L1–S1 levels.