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Original Research

Dynamic Ultrasonography of the Deep External Rotator Musculature of the Hip: A Descriptive Study

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Abstract

Background: No detailed reports exist describing the methodology of ultrasound image acquisition of the deep external rotator muscles of the hip. Because gluteal pain and sciatica are common, ultrasound may be a useful dynamic imaging adjunct in the evaluation of these patients.
Objective: To describe dynamic ultrasonography of the deep external rotator muscles of the hip for diagnostic purposes.
Design: Descriptive.
Setting: University radiology department.
Participants: Participants (n = 25; 14 male) without gluteal pain or sciatica were enrolled (mean age 27.6 ± 4.7 years; mean body mass index 26.0 ± 4.1 kg/m^2).
Methods: Ultrasonographic cine clips oriented to the long axis of each deep external rotator muscle were captured. In addition, cine clips of the piriformis tendon and obturator internus tendon were obtained. Cine clips were analyzed approximately 1 week after completion of image acquisition independently by 2 blinded raters.
Main Outcome Measures: A 5-point Likert scale to evaluate the diagnostic utility of the ultrasound image.
Results: The modal Likert scores for rater 1 were as follows: piriformis muscle = 4; piriformis tendon = 4; superior gemellus muscle = 3; obturator internus muscle = 4; obturator internus tendon = 4; inferior gemellus muscle = 4; quadratus femoris muscle = 4. The modal scores for rater 2 were: piriformis muscle = 4; piriformis tendon = 3; superior gemellus muscle = 4; obturator internus muscle = 3; obturator internus tendon = 4; inferior gemellus muscle = 3; quadratus femoris muscle = 4.
Conclusion: Dynamic ultrasonography may be useful to image the hip deep external rotator musculature for diagnostic purposes and therefore aid in the evaluation of gluteal pain and sciatica. Future work should investigate the reliability and validity of ultrasonography in the evaluation of pathology of these muscles.

Introduction

Gluteal pain and sciatica are common conditions in which the deep external rotator musculature of the hip frequently is implicated as a source of pathology [1-3]. These structures, located within the subgluteal space, include the piriformis muscle and tendon, superior gemellus muscle, obturator internus muscle and tendon, inferior gemellus muscle, and quadratus femoris muscle [3]. With the exception of the piriformis, the sciatic nerve lies on the posterior surface of each of these muscles. Typically the sciatic nerve emerges from the greater sciatic foramen anterior to the piriformis muscle; however, anomalous anatomy exists in approximately 16.9% of the population [4]. Although the prevalence of gluteal pain is unknown, the lifetime prevalence of sciatica is wide-ranging, with estimates between 1.6% and 43% [5]. Regardless, gluteal pain with and without extraspinal sciatica are common complaints that have received increased attention as of late [3,6].

Piriformis syndrome is perhaps the most well-known pathology of this muscle group; however, despite a report in which the investigators used magnetic resonance neurography [7], it currently remains a diagnosis of exclusion [8,9]. Conversely, ischiofemoral impingement, which is pathology of the quadratus femoris muscle secondary to a narrowed ischiofemoral space (the space between the lesser trochanter and ischial

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tuberosity), is being reported increasingly in the orthopedic and radiologic literature and has well-defined clinical and imaging manifestations [10]. The obturator internus and gemelli muscles form what is known as the obturator-gemelli complex, and pathology of these muscles may mimic piriformis syndrome and also must be considered in the etiology of gluteal pain and extraspinal sciatica [11-13].

Ultrasonography (US) in this region principally has been investigated in the imaging of the deep external rotator muscles to guide interventional procedures. Specifically, injection of the piriformis muscle [14], the intrapelvic portion of the obturator internus muscle [15,16], the obturator internus tendon sheath and bursa [15], and the quadratus femoris muscle [17] have been described. Recently, US also has been used to guide electrodes into the obturator internus muscle for electromyography studies and to measure the cross-sectional area of the quadratus femoris muscle and the ischiofemoral space [18-20]. Evaluation by US of these muscles to diagnose muscle or tendon pathology, however, has not been investigated. Considering the dynamic capabilities of US, it is an attractive imaging modality by which to study the deep external rotator muscles of the hip. Furthermore, US is safe, portable, well tolerated by patients, uses no ionizing radiation, and is less expensive than other soft-tissue imaging modalities, namely magnetic resonance imaging (MRI) [21,22].

Although the recent technological advances in US have allowed for greater resolution of primarily superficial musculoskeletal structures [21], based on the reports mentioned previously, it is possible to resolve the deep external rotator muscles of the hip with US. Because gluteal pain and extraspinal sciatica seemingly involve pathology of these muscles, describing US imaging of these structures for diagnostic purposes may have strong clinical implications. Therefore, the aim of this study was to apply a Likert scale investigating the diagnostic value of dynamic US when the deep external rotator musculature of the hip is imaged, including the piriformis and obturator internus tendons.

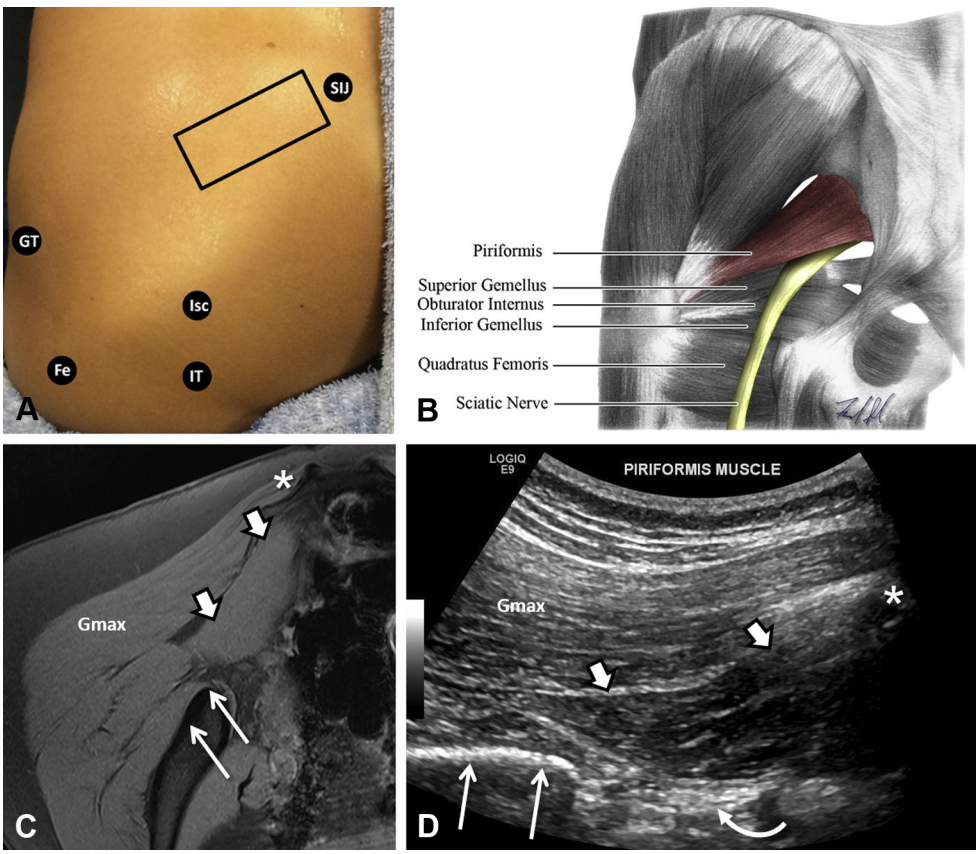

Figure 1. Topographical orientation for US transducer placement to image the deep external rotator muscles. (A) Bony landmarks of the sacroiliac joint (SIJ), greater trochanter (GT), ischium (Isc), posterior femur (Fe), and ischial tuberosity (IT) are highlighted with black circles. The solid black rectangle represents the orientation of the US transducer to image the piriformis muscle in long axis as it emerges from the greater sciatic foramen. Anatomical plate (B) demonstrates the gross anatomy of the deep external rotator muscles and sciatic nerve. Transverse MRI (C) and US (D): The piriformis muscle (short arrows) is visible in long axis anterior to the gluteus maximus muscle (Gmax) as it emerges from the anterior sacrum (asterisk) and courses posterior to the ilium (long arrows). The sciatic nerve (curved arrow) is visible on the US image as an ovoid hyperechoic structure deep to the piriformis muscle. US = ultrasound; MRI = magnetic resonance imaging.