

Case Study

Rare Variant of Vastus Medialis Detected *in vivo* by Ultrasound and Confirmed by High-resolution MRI

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Abstract. [Purpose] This report describes an unusual incidental finding during ultrasound investigation of the vastus medialis muscle. Volunteers underwent ultrasound scanning as part of an on-going investigation into the architecture of the vastus medialis muscle. [Subjects and Methods] The distal thighs of forty-one subjects were scanned using the Philips iU22 US system. An unusual muscle morphology was detected bilaterally in one subject, who then underwent a 3T Magnetic Resonance Imaging (MRI) scan in order to further investigate the muscle morphology. The subject in question was a 32 year-old female who suffers from recurrent bilateral patellar dislocations. [Results] The MRI scan confirmed the ultrasound findings, and indicated the presence of the vastus medialis in two layers, with the VML continuing deep, separate from the VMO. [Conclusion] Although this rare variant has been reported in previous cadaveric studies, we believe this to be the first report in the literature of this morphology *in vivo*. The biomechanical implications of this muscle arrangement are unknown, but it may not be without significance that this individual suffers from recurrent patellar dislocations.

Key words: Vastus medialis, Ultrasound, MRI

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INTRODUCTION

The quadriceps muscles of the anterior thigh consist of the rectus femoris and the vasti: the vastus medialis, the vastus lateralis and the vastus intermedius. The vastus medialis (VM) originates from the lower part of the intertrochanteric line, medial lip of the *linea aspera* and upper third of the medial supracondylar line, and has distal attachments via an aponeurosis to the quadriceps tendon and the medial border of the patella¹⁾. The proximal and distal parts of the vastus medialis are commonly described as being separate parts of the same muscle, the vastus medialis oblique (VMO) distally, and the vastus medialis longus (VML) comprising the proximal part of the muscle²⁾. A rare variant has been reported in the literature in which the VMO is present as a separate, superficial layer covering the VML, thus forming a bilaminar structure^{3–5)}. These reports have hitherto been confined to cadaveric studies. Here we report for the first time a similar finding *in vivo*, detected during routine US scanning and subsequently confirmed by high-resolution MRI.

SUBJECTS AND METHODS

A total of forty-one volunteers underwent an ultrasound (US) scan of the distal antero-medial thigh in order to investigate the architecture of the vastus medialis oblique. Approval for this research was obtained from the local Research Ethics Committee. All subjects gave their informed written consent prior to being scanned. Scanning was carried out using the Philips iU22 US system with a 15–7 MHz linear-array probe, at the Radiography Department of St. George's Hospital NHS Trust, London, UK. To enable further investigation of an unusual ultrasound presentation detected in one individual, the subject gave consent for us to carry out an MRI scan. MRI data were acquired with a 3T Philips Dual Tx Acheiva using a 32-channel torso imaging coil placed around the upper legs and extending down to the knees. A 3D volumetric coronal T1-weighted image was acquired using the eTHRIVE sequence with the following parameters: 380 mm by 380 mm by 180 mm field-of-view with 0.75 mm isotropic resolution; TR 3.6 ms, TE 1.77 ms, flip angle 10°; SPAIR fat suppression with a 240 ms inversion time; 1.6 SENSE factor in two directions and two signal averages.

RESULTS

An unusual morphology was detected by US scan, bilaterally, in a 32 year-old female who was known to suffer from recurrent patellar dislocation (Fig. 1a). A “normal” image is shown for comparison (Fig. 1b). The control sub-

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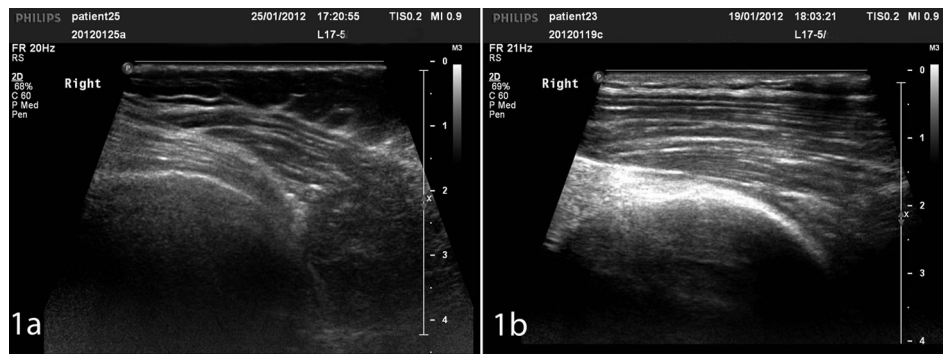


Fig. 1. a) Unusual two-layered presentation of VM seen on the US monitor b) Usual US presentation of VM in a control subject

ject was a 21 year-old asymptomatic male. Findings in all the other subjects were unremarkable.

In the subsequent MRI scan, a plane of separation in the belly of VM was found, which is indicated by the arrowhead in Fig. 2a. A control scan at the corresponding axial level is shown in Fig. 2b. The control subject was a 34 year-old asymptomatic female.

DISCUSSION

The separate existence of the VMO and VML has been a matter of controversy for some years. It has been claimed by some authors that the distal VMO functions separately from the VML, and is significant in medial patellar stabilisation. An abrupt change in muscle fibre angle, and/or the presence of a fascial plane have been cited as evidence of a separation between VMO and VML^{1, 2, 6} although other authors have disputed this⁷⁻⁹. There have been three reports in the literature of an unusual variant found in cadaveric specimens in which the VMO and VML are incontrovertibly separate entities, as the VML ran deep to a distal and superficial VMO, so that the VMO existed as a separate layer, superficial to the VML. This variation has been reported in 5 out of 22 cadaveric lower limbs³, three out of “more than a hundred” dissected lower limbs³, and bilaterally in one out of a sample of 200 Nigerian cadavers, which the authors called an “accessory quadriceps femoris muscle”²⁴. As far as we are aware, there have thus far been no reports of this unusual variation in living patients encountered in clinical practice. While carrying out US investigations into VM muscle architecture, a volunteer with a known history of recurrent bilateral patellar dislocations was found to have an unusual presentation (Fig. 1a), which differed markedly from the usual appearance of the US image (Fig. 1b). The unusual presentation was bilateral. We suspected that this might have been indicative of a double-layered VM, and this was subsequently confirmed by axial MRI images (Fig. 2a and 2b). Figure 2a shows a clear and continuous line of separation within the muscle belly of VM, corresponding to the separate layers of the VML and VMO. This appears to be only the second time that this variation has been recorded bilaterally, and the first ever report of it *in vivo*. The biomechanical implications of this arrangement are at present unknown, but it could be that the presence of the VMO as a thin superficial lamina reduces its physiological cross-sectional area and hence its effectiveness as a medial stabi-

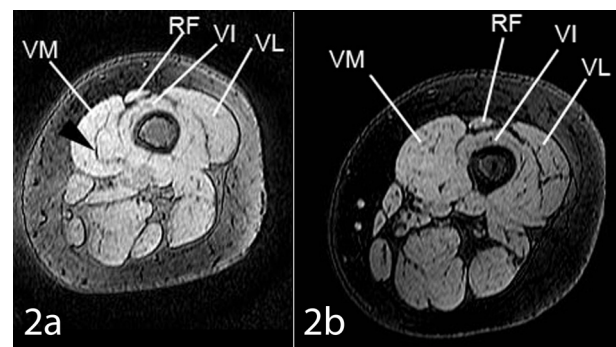


Fig. 2. a) Axial MRI, left thigh. RF rectus femoris, VI vastus intermedius, VL vastus lateralis, VM vastus medialis. Black arrowhead indicates plane of separation between VMO (superficial) and VML (deep). b) Control subject. No plane of separation visible in VM at the corresponding axial level. Abbreviations as in Fig. 2a.

liser of the patella. Thus, it may not be without significance that this individual suffers from recurrent patellar dislocations. Work is on-going to establish if this morphology has a higher incidence among patients presenting with recurrent patellar dislocations or patellar instability.

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