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# Rare variant of psoas minor or a newly observed component of the iliopsoas muscle complex? Case report

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**ABSTRACT**

**Background:** Multiple structures found in different compartments of the human body are considered as morphologically variable, however, this general assumption does not apply to the components of the iliopsoas muscle complex. In this study, we report a case of an extremely variable muscle observed in the above-mentioned compartment.

**Materials and methods:** During a routine dissection of the posterior abdominal wall of a 78-year-old male cadaver, an anomalous muscle with an atypical morphology was observed, photographed and subjected to further measurements.

**Results:** Although the anatomy of the dissected posterior abdominal wall structures seemed typical, a variable muscle was observed that consisted of multiple additional muscular components.

**Conclusions:** Awareness of morphological variability was proven to be useful for clinicians from different fields of medicine. Therefore, the anomaly observed in the compartment which is considered to be rather constant seems relevant as this unknown structure may lead to further misconceptions during the process of diagnosis and treatment.

**Keywords:** iliopsoas muscle complex, psoas minor, psoas major, iliacus muscle, morphological variability

## INTRODUCTION

The iliopsoas muscle complex is distinguished based on the common function (the strongest hip flexion) and distal insertion (the lesser trochanter of femur) of its main components, i.e. the iliacus muscle and the psoas major [12]. If the psoas minor is observed, it is also included as an integral part of the complex [22].

The psoas minor is usually described as a small, flat, fusiform muscle that typically originates from the twelfth thoracic vertebra, the first lumbar vertebra and the intervertebral disc situated between them. It forms a short and slender muscular belly that descends inferiorly and becomes a long tendon that reaches the pectineal line of the pubis, the iliopectineal eminence and the iliac fascia [12].

As a component of the iliopsoas muscle complex, the psoas minor functions just like the other muscles included in the structure. Its main role is to participate in the hip and lumbar spine flexion, aid stabilization of the lumbar spine and the sacroiliac joint (SIJ). Also, the psoas minor stretches the iliac fascia and the iliopectineal arch, which extends the muscular space and prevents compression of the femoral nerve (FN) [10, 12, 20, 21].

The most frequent variation of the psoas minor is associated with its presence. It is well documented that of all the muscles in the body, the psoas minor has the greatest propensity for agenesis (it reaches 56%, although differs between the ethnicities) [20]. Anomalies of the psoas minor morphology were also observed, however, they occur rather seldom. There are reports on alternative insertions including the inguinal ligament, the neck of the femur or the lesser trochanter, or an extra attachment between the fifth lumbar vertebra and the sacrum [6]. There are also few reports on additional muscles such as psoas accessories, or cases of a double headed psoas minor [10, 20].

To our knowledge, the presented case of an anomalous muscle identified in the iliopsoas muscle complex has not been reported before.

## CASE REPORT

An atypical muscle was identified during a routine dissection of the right posterior abdominal wall of 78-year-old male cadaver that was performed according to the standard techniques for research and teaching purposes, at the Department of Anatomical Dissection and Donation, Medical University of Lodz, Poland.

The cadaver was placed in the supine position on the dissecting table. The intestines were separated from the greater omentum, the mesentery and fatty tissue in order to obtain a clear view of the posterior structures of the abdominal wall. The components of the lumbar plexus and iliopsoas muscle complex were cleared and identified. Presence of an unusual muscular structure was revealed.

The variable muscle was characterized by four main heads, the intermediate tendon and seven additional muscular bands located between the intermediate tendon, the fourth and fifth lumbar vertebrae and the sacral bone. The first (superior) head originated from the shaft of the twelfth thoracic vertebra, the shaft of the first lumbar vertebra and the intervertebral disc between them, formed a flat, fusiform muscular belly that ran downwards and transformed into an intermediate tendon characterized by a thin, fibrous structure, that descended medially and reached the pectineal line of the pubis. On its course, the intermediate tendon produced three (inferior) muscular heads, i.e. lateral, intermediate and medial, positioned next to each other and characterized by muscular fusions occurring between them. The inferior heads ran downwards to the insertion point. The lateral and intermediate heads produced tendinous fusion with the posteriorly located psoas major that originated the level of the inguinal ligament and extended to the lesser trochanter of the femur, the site of insertion for inferior heads. Medially, between the level of the superior and inferior heads, the intermediate tendon produced seven muscular bands that extended between tendinous tissue, the fourth and fifth lumbar vertebrae and the sacral bone. The first and second muscular bands ran onto the shaft of the fourth lumbar vertebra; the third onto the shaft of the fifth lumbar vertebra; the fourth, fifth, sixth and seventh bands were inserted onto the lateral part of the pelvic surface of the sacrum. The fourth muscular band was inserted superiorly and slightly medially to the first anterior sacral foramen. The fifth muscular band was inserted inferiorly to the fourth one. The sixth and seventh muscular bands were inserted between the first and second anterior sacral foramina in a position similar to that of the muscular bands located above (Fig. 1, 2)

The L4 and L5 ventral rami of the lumbosacral plexus were identified between the described additional muscular bands. The L4 ventral ramus was located beneath the first muscular band, anteriorly to the second muscular band, and the L5 ventral ramus was found between the second and third muscular bands.

The anomalous muscle was subjected to detailed morphometric measurements and photographic documentation. All the measurements were taken three times with an accuracy of up to 0.1 mm, using an electronic caliper (Mitutoyo Corporation, Kawasaki-shi, Kanagawa, Japan). The results are presented in Table 1.

**Table 1.** Morphometric measurements of the anomalous muscle.

| **Additional muscular bands** | **Measurement [mm]** | | |
|---|---|---|---|
| | **PA width** | **PA thickness** | **Band's length** |
| First band | 5.68 | 1.12 | 76.19 |
| Second band | 7.73 | 2.85 | 79.99 |
| Third band | 5.10 | 0.98 | 89.06 |
| Fourth band | 9.13 | 3.50 | 94.05 |
| Fifth band | 4.60 | 2.50 | 81.25 |
| Sixth band | 8.97 | 1.58 | 70.40 |
| Seventh band | 9.54 | 2.92 | 81.27 |
| **Intermediate tendon** | **DA width** | **DA thickness** | **Tendon's length** |
| | 23.41 | 2.65 | 137.15 |
| **Main heads** | **PA width** | **PA thickness** | **Head's length** |
| Superior head | 44.34 | 5.36 | 132.71 |
| Medial head | 13.27 | 3.69 | 115.74 |
| Intermediate head | 10.20 | 2.18 | 79.53 |
| Lateral head | 65.33 | 4.53 | 148.80 |
| **MTJ** | 23.32 | 2.65 | - |
| **Muscle's length** | 339.49 | | |

## DISCUSSION

As previously mentioned, the variability of the psoas minor is most frequently associated with its presence. In fact, together with the plantaris muscle, the palmaris longus muscle, the peroneus tertius and the pyramidalis muscle, it is considered as one of the most common muscles that became vestigial during the evolution process [21]. Fundamentally, the psoas minor is the leading example of a vestigial muscle since, as reports suggest, the probability of its congenital absence is evaluated to be 56% [22].

Interestingly, racial disparity has been reported in a number of previous studies devoted to the presence of the psoas minor. According to Mori et al. [13], who reviewed reports on the Japanese population, it ranged from 35% to 55%, whereas Hanson et al. [9], who compared prevalence of muscles between young black and white men, it was absent in 91% of black subjects and only in 13% of white individuals. According to the current medical knowledge, there exists no difference in the prevalence of the psoas minor muscle between males and females [21].

When it comes to its morphology, most frequently the psoas minor varies in terms of its insertion site. The alternative insertions include the inguinal ligament, the neck of the femur or the lesser trochanter or the additional attachment between the fifth lumbar vertebra and the sacrum [6]. Although reports on additional structures are few, they may still be found.

Joshi et al. [10] described psoas accessories, an additional muscle that originated from the deep surface of the psoas minor tendon and spread anteriorly to the psoas major. Protas et al. [20] observed occurrence of a double-headed psoas minor that was composed of a lateral head that originated from the first lumbar vertebral body and from a medial head that arose from the fourth and fifth lumbar vertebral bodies, and from the intervertebral disc between them. Both heads merged together and formed a long tendon inserted into the iliopectineal eminence [20]. Nevertheless, to our knowledge, current literature on anatomy includes no report or information on a variation as complex as the case observed by us.

Interestingly, even though occurrence of such a variation in the iliopsoas muscle complex was not thoroughly examined, the described example contains numerous analogies to another anomalous structure observed on the upper medial part of the arm, called the coracobrachialis longus (CBL).

The CBL is a rare variation of the coracobrachialis muscle (CBM) [1] . Classically, the CBM originates from the apex of the coracoid process of the scapula and joins biceps brachii muscle at the anteromedial surface and the medial border of the shaft of the humerus [16, 17, 25]. The belly of the CBM muscle is divided into three parts, i.e. proximal, arising from the coracoid process, middle and the most superficial distal part [25, 26]. The proximal part of the CBL corresponds with the classical description of the CBM, since it originates from the apex of the coracoid process, therefore, if present, the CBL can be mistaken for the superficial part of the CBM [8]. However, the insertional tendon of the CBL is located closer to the elbow joint and was reported to run onto the shaft/medial epicondyle of the humerus/ fibrous band of the medial intermuscular septum/Struther’s ligament/latissimus dorsi muscle or the olecranon [15].

The morphology of the muscle presented in this study is characterized by numerous similarities to the structure of the CBL, especially to the type II proposed by Zielinska et al. [25]. Type II is described as a structure with a classical CBM proximal attachment that forms the first muscular part of the muscle. It then transforms into a thin fibrous layer that undergoes further modifications to become the second muscular part of the muscle. It becomes tendinous, runs onto the olecranon, and it is also fused with the insertional tendon of the triceps brachii [25].

Firstly, the muscle presented in this study originated in accordance with the classical description of the psoas minor and formed the first muscular belly (the superior head), which concludes the first resemblance to the CBL morphology. Secondly, the muscular belly transformed into a thin fibrous, tendinous layer, just as in the description of type II. The described intermediate tendon formed three separate muscular bellies (lateral, intermediate and medial heads), similarly to the CBL, however, with slight differences, i.e. the fibrous tendinous insertion of the CBL runs onto the humerus and then transforms completely to the single second muscular belly, while in the presented study, the intermediate tendon spread medially and on its course formed three additional bellies. Lastly, the described lateral and medial heads were not only fused with the psoas major, but also all the inferior heads fused alongside with the other components of the iliopsoas muscle complex onto the lesser trochanter of the femur. Type II of the CBL is characterized by fusion with the biceps brachii, and additionally, similarly to this muscle its insertion site is the olecranon, which concludes the last morphological resemblance between the two variants.

As regards similarities between this study and the CBL in clinical matter, compressive and entrapment peripheral neuropathies must be addressed. Even though peripheral nerve compressions may occur anywhere along the course of the nerve, they are most likely to be observed where the nerve passes through fibro-osseous/ fibromuscular tunnels or penetrates the muscle [5, 11, 15]. When the CBL is present, there may occur brachial plexus block, compression of the lateral cord or even compression of the musculocutaneous, median and ulnar nerves, depending of the complexity of CBL variation [7, 15]. This may result in hypoesthesia and paralysis within the forearm muscles. Since the iliopsoas muscle complex is closely related to the lumbosacral plexus, possible compression of its components has been stressed many times [2, 4, 22–24]. It can be assumed that the complex morphology of the psoas minor muscle, just as presented in this study, may contribute to nerve compression since the components of the described plexus were located between the muscular parts of the variation analyzed.

In the present study, the L4 ventral ramus was located beneath the first muscular band, anteriorly to the second muscular band, and the L5 ventral ramus was identified between the second and third muscular bands. According to the classical anatomical description, the L4 and L5 ventral rami are involved in the formation of the femoral nerve, the obturator nerve, the superior gluteal nerve, the inferior gluteal nerve and the sciatic nerve [3, 12]. The position of the described rami specific to the presented case may be associated with a probability of compression, especially during contraction of additional bands. Possible consequences of compression of the lumbosacral plexus at a such high level remain unknown and can only be speculated. Perhaps such a compression could impair functions of nerves arising from the rami, which could further result in a disturbed innervation pattern of muscles supplied by these nerves. Nevertheless, further studies on this subject are necessary to confirm the presented hypotheses.

As previously mentioned, the psoas minor supports the functions of the iliopsoas muscle complex and one of those functions, particularly performed by the psoas major, is stabilization of the SIJ [14]. It can be hypothesized that numerous additional muscular slips stretched between the psoas minor and the sacral bone, positioned anteriorly to the SIJ, may provide additional support for stabilization of the described joint. However, it needs to be stressed that the analyzed variation occurred unilaterally only and, as mentioned by Pośnik et al. [18, 19] unilateral presence of a compound variation within the iliopsoas muscle complex could actually disturb the force distribution within the muscles, which would lead to differences in force arrangement patterns on both sides, and thus disrupt the functions, such as stabilization of the lumbar spine, support of the lumbar lordosis or positioning of the pelvis, or in this case specifically, impair stabilization of the SIJ. Nonetheless, further studies are required to confirm or deny the proposed theory.

## CONCLUSIONS

We report a case of an extremely variable muscle found within the iliopsoas muscle complex, and to emphasize its morphological and clinical resemblance to the CBL. It is important to be aware of its occurrence for many reasons. Firstly, the existence of this variant contradicts the general opinion about a rather constant morphology of the components that form the iliopsoas muscle complex. Secondly, the strong resemblance between variable structures of different body regions, i.e. the upper medial part of the arm and the posterior abdominal wall, needs further investigation. Lastly, there are numerous clinical implications that may result directly from occurrence of such a variation, therefore clinicians should familiarize themselves with documentation on this issue and, in some relevant cases, consider the described variant to improve the process of diagnosis.

## Article information and declarations

### Ethics statement

The cadavers belonged to the Department of Anatomical Dissection and Donation, Medical University of Lodz.

### Author contributions

Marta Pośnik — project development, data collection and management, data analysis, and manuscript writing. Andrzej Węgiel — data collection, data analysis, and manuscript editing. Nicol Zielinska — data collection, data analysis, and manuscript editing. Bartłomiej Szewczyk — data analysis and manuscript editing. Piotr Łabętowicz — data analysis and manuscript editing. Bartosz Gonera — data analysis and manuscript editing Łukasz Olewnik — supervision, data analysis, and manuscript editing. All authors have read and approved the manuscript.

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**Conflict of interest**

The authors declare that they have no competing interests.

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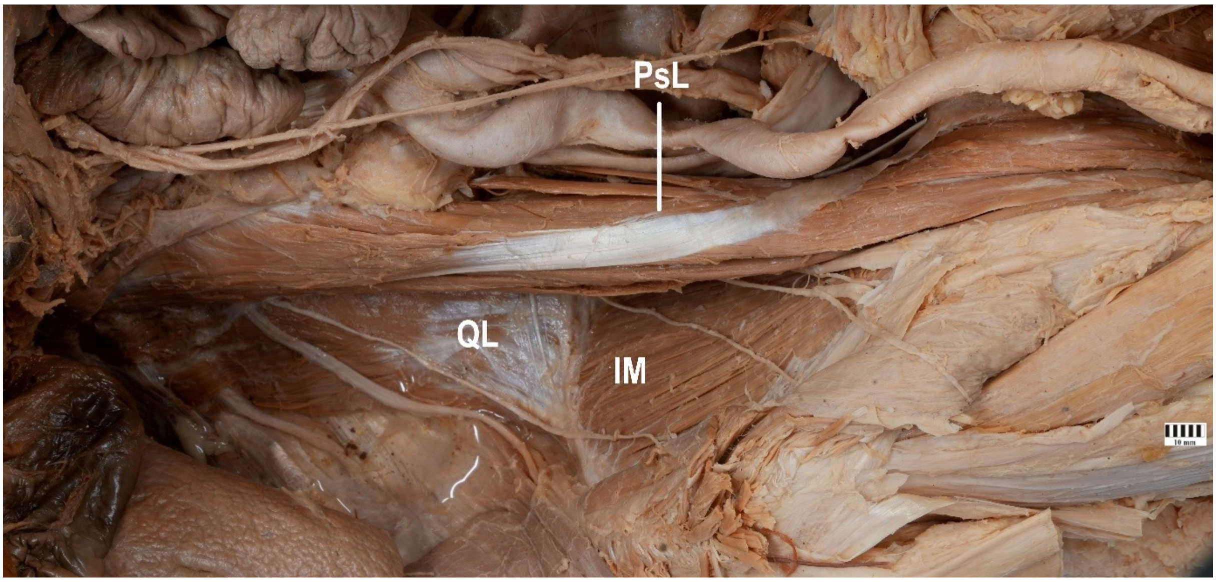


**Figure 1.** Abdominal wall during dissection. IM — iliacus muscle; PsL — variable muscle; QL — quadratus lumborum.

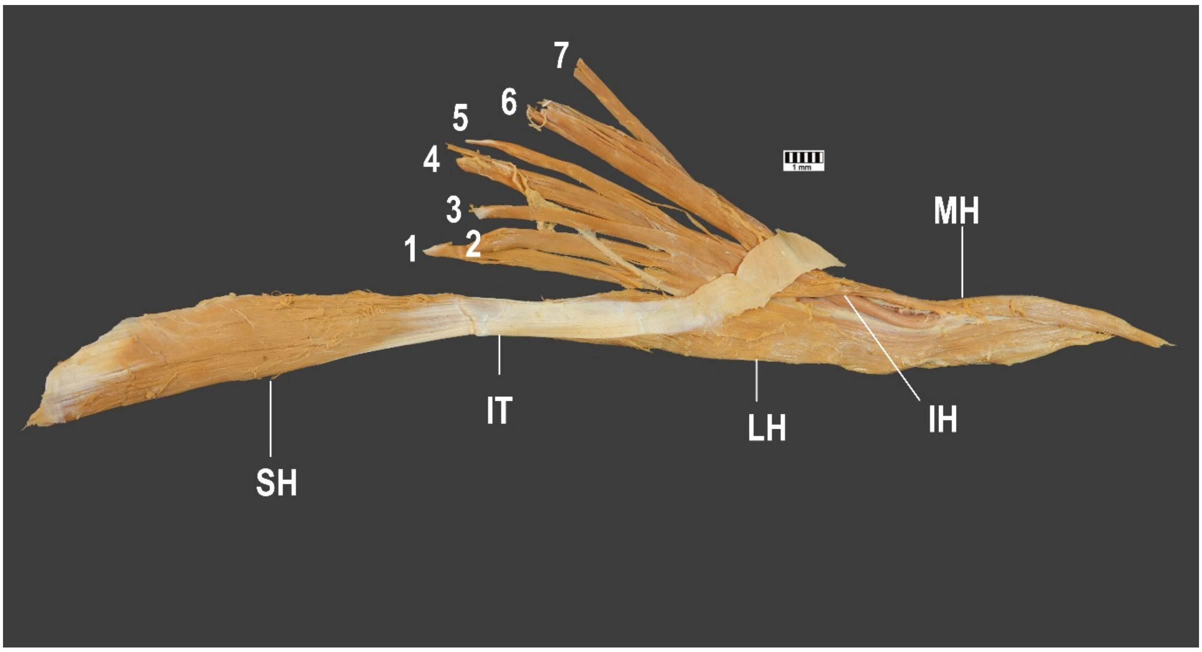

**Figure 2.** Variable muscle after extraction. 1–7 — additional muscular bands; IH — intermediate head; IT — intermediate tendon; LH — lateral head; MH — medial head; SH — superior head.