

**IJCRR**

Vol 05 issue 14

Section: Healthcare

Category: Case Report

Received on: 10/06/13

Revised on: 24/06/13

Accepted on: 19/07/13

ANATOMICAL AND CLINICAL INSIGHT OF VARIANT MORPHOLOGIES OF PSOAS MINOR MUSCLE: A CASE REPORT

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ABSTRACT

Psoas minor is long, slender and functionally weak muscles that assist psoas major in flexing the trunk and spinal column. Psoas minor at its origin lies just in front of the psoas major muscle has small belly and long tendon like plantaris and palmaris longus muscle. Psoas minor receives its nerve supply from the ventral rami of L1 spinal nerves, which after piercing through the psoas major muscle enter into the muscular belly. In the present case, psoas minor muscle was found bilaterally in a 60 years old male formalin fixed cadaver. Bilaterally, the muscle depicted absence of fusion with adjacent psoas major and was found to exist independently. The distal insertion of the muscle was variable when compare to the contralateral peer. Moreover, in contrast to the muscular portion, the tendinous portion was remarkably lengthier. As the muscle is closely related to important neurovascular structures of retroperitoneum, it may compress them during its involvement in psoas minor syndrome and psoas abscess; yielding myriads of clinical signs and symptoms. The incidence and morphometric parameters of this inconsistent muscle are highly variable and had been frequently correlated with ethnic and racial characteristics. The current report reveals a case of bilateral existence of psoas minor and disparity in its morphometric attributes on either side. Against this background, analysis of deviation in structural architecture and its distribution in population has been attempted. To consolidate the scattered pieces of information about variability in different parameters of this muscle and reemphasize its significant role in radiographic and surgical procedures, a review of literature is constructed to appraise the medical persons working in related fields.

Keywords: Psoas major, Psoas minor, Psoas minor syndrome, variations

INTRODUCTION

The Psoas minor muscle is a constituent of the posterior abdominal wall and lies ventral to the psoas major muscle. When present, it usually originates from the lateral sides of the body of the twelfth thoracic vertebra (T12), first lumbar vertebra (L1), and the intervening intervertebral disc. The short muscular part is continuous with a thin tendon, which is inserted into the iliopubic eminence, pectineal line of the pubis and laterally in the iliac fascia^{1,2}. The psoas minor muscle have been found to flex the lumbar spine and tilts it sideways when contracting unilaterally³, apart from providing stabilization to the hip joint⁴. It is

classified as an inconsistent muscle⁵ and is often absent³. It is considered the muscle with highest percentage of unilateral or bilateral agenesis, considered ranging from 40% to 66% in different populations^{2,5}. In case of its existence, the thin tendon of this muscle can rarely arise from an expansion of the medial border of the psoas major muscle⁵.

Morphometric and morphological descriptions on the psoas minor muscle are scarce, discrete and unorganized in the literature and do not provide any conclusive anatomical information about the muscle. The aim of the present study is to reveal the anatomy of the psoas minor muscle, ascertain

their origin and insertion points, analyze the possible dependent relationship between the fibers of the psoas minor and major muscles, neurovascular relations and determine the proportional relationship between the tendinous and muscular parts of the psoas minor. We also aim at providing an insight into the clinico-surgical importance of this variant muscle.

CASE REPORT

During the course of routine cadaveric dissection for undergraduate students of a 60 year old male cadaver, the posterior abdominal wall revealed the bilateral existence of well formed psoas minor muscle taking origin from the lateral surfaces of the body of T12 & L1 vertebra and from intervening tendinous arch (fig. 1a & 1b). Bilaterally the psoas minor muscles were getting inserted onto the iliopubic eminence, the insertion being tendinous on the left side (fig1b) and tendinoaponeurotic that fuses with the iliac fascia on the right side. On further exploration, the length of left sided psoas minor measured as 10.5 cm and 12 cm for the muscular and tendinous part respectively (fig 1b). The maximum width of the muscle at muscular and tendinous part was 2.50 cm and 0.90 cm in that order (1b). On the right side, length of muscular belly and the variant tendinoaponeurotic part when compared to the left measured as 11 cm and 10.50 cm (fig1a). The maximum widths of muscular, tendinous and aponeurotic parts of the right sided psoas minor were 2.50 cm, 0.50 cm and 4.50 cm respectively (fig1a). The genitofemoral nerve, which pierced the psoas major muscle, oriented itself along the medial border of psoas minor muscle bilaterally.

On both sides, the tendons of muscle were found positioned lateral to the external iliac artery. Bilaterally, they received the nerve supply from anterior division of L1 spinal nerve. No contracture, lump, tumor fixation or signs of injury were seen in the muscles. The cause of

death of the case was apparently unrelated to previously mentioned variant findings.

DISCUSSION

The psoas minor muscle varies considerably in its morphology and morphometry. The possible variations in the morphology of psoas minor muscle can be broadly discussed and reviewed by taking into account the following parameters.

Incidence of psoas minor- In majority, psoas minor muscle is deficient similar to commonly absent muscles like pyramidalis, psoas parvus, peroneus tertius, palmaris longus, and plantaris⁶. In major studies, the incidence of existence of psoas minor was found to exhibit a range of findings such as 30%⁶⁻⁹. The relative discrepancy in frequencies is presumed to be correlated with the racial and ethnic differences in the population^{6,10}. They are illustrated in table 1

Gender bias- The higher occurrence of this muscle in females compared to males⁶ had been contradicted in other study, where the gender bias was found to be insignificant⁷. No scientific dictums regarding its probable correlation of its incidence with any particular gender was later established⁶.

Variations in origin and insertion- Usually it finds its attachment on the first two lumbar vertebrae and the intervening intervertebral disc similar to present case. Infrequently it might originate through two heads, which may segregate partially or completely prior to its distal insertion on iliopubic eminence. Alternatively, its insertion may be erratically located at iliac fascia, inguinal ligament, neck of the femur or lesser trochanter in unison with psoas major. The tendinous insertion can bifurcate, leading to the attachment of additional aberrant band on the synchondrosis between the fifth lumbar vertebra and the sacrum, apart from its usual insertion at iliopectineal line⁶. The muscle may merge with the pelvic or iliac fascia, through which it possibly gets attached to crural arch^{6,11} which

simulates the findings observed in right sided psoas minor in the current case.

The duplication of psoas minor has also been seen in the past, where the first belly overlapped the other from before backwards⁶. Infrequently, the ramifications of muscular fibers of psoas major yielding psoas minor have been mentioned as source of unusual origin⁶.

Proportional extent of muscular and tendinous parts- Remarkably long tendons of psoas minor muscle have been accounted in the precedent history^{5,12}. Absolute tendinous replacement of this muscle is also reported in different studies^{6,13}. However, the literature provides inconclusive data on the proportional relationship between the extent of muscular and tendinous parts of the psoas minor.

Side difference- although the relative absence of this muscle on the right side compared with the left is mentioned⁶. The preferential presence on either side remains statistically unresolved.

Probable functions of the muscle- Psoas minor, if present, exerts minimal contribution in the flexion of lumbar spine^{14,15}, yet it reinforces psoas major in maintaining lordotic lumbar curvature through the sustained tone inherent in itself¹⁵.

Comparative anatomy- psoas minor has been found to be well developed in hopping animals like marsupials, macrocelides, jerboa etc⁶.

CLINICAL IMPLICATIONS

The psoas minor syndrome is attributed to unusual high tone in psoas minor muscle and tendon¹⁵ where, the patient complaints of pain in the lower quadrant of the abdomen. In addition, the pain was aggravated by palpation of the taut tendon in lean individuals presenting with acute abdomen¹⁵. In this syndrome, there is the limited extension, which impairs ambulation. Tenotomy is the only treatment of choice, which relieves the symptoms. This remarkable entity may simulate the pain of appendicitis or diverticulitis localized in iliac fossae¹⁵. Psoas minor, functioning as an adjunct to psoas major, may be variably involved

in psoas compartment syndrome¹⁶. The psoas minor muscle being a retroperitoneal structure lies in close proximity to important neurovascular structures in the posterior abdominal wall. Infections, hematoma and neoplasm localized in the retroperitoneal planes have propensity to involve the adjacent psoas fascia and muscle¹⁷.

Moreover, as the cranial portion of psoas minor is placed posterior to crural attachment of diaphragm, any pathological collection within the confinement of fascia overlaying the muscle may gain access to endothoracic cavity. The comprehension of these muscular variations allows insight into the pattern of localization and spread of infection and malignancy in the retroperitoneal region of the body¹⁸. The space occupying lesions situated in psoas muscles may impinge on the related nerves of lumbar plexus leading to motor or sensory neurological deficits of lower limb¹⁸. Psoas compartment block has been inferred as useful alternative in alleviation of postoperative pain following hip and knee surgeries; hence, the comprehension of morphological variations of psoas minor is imperative for success of such techniques¹⁹. The variant muscle as observed in the current case should not be confused with the retroperitoneal lymphadenopathy. Since the originating head of psoas minor lies in posterior relation of renal pelvis and neurovascular pedicles, it may interfere with the operative field in percutaneous nephrolithostomy. In aberrant lower spinal curvature correction surgeries, the role of lengthening of predominantly tendinous configuration of psoas minor must be considered. To address the lack of information in the literature regarding psoas minor muscle's morphology, morphometry and its clinical implications, this case endeavor to provide detailed information about the muscle in order to expand knowledge of its clinical anatomy.

CONCLUSION

The clinicians and academicians have often overlooked the role of psoas minor owing to its relative scarcity of anatomicosurgical comprehension. The review of psoas minor and its crucial disposition in the retroperitoneum would serve to appraise and guide the interventional procedures and differential diagnosis of relevant simulating clinical conditions.

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| Incidence of presence of Psoas minor in different population and ethnic groups | | | |
|---|------------------------------|-----------------------------|-----------|
| S.No. | Researchers | Population and ethnic group | Incidence |
| 1. | Bergman RA et al (6) | Asians | 51.1% |
| | | Whites | 43% |
| | | Negroes | 33.4% |
| 2. | Mori et al (10) | Japanese | 46.4% |
| 3. | Gruber et al (cited by 10) | Russians | 52% |
| 4. | Schwalbe et al (cited by 10) | Alsations | 43% |
| 5. | Thomson et al (cited by 10) | English | 41% |
| | | Scotsmen | 37% |
| | | Irish | 34% |
| 6. | Loth et al (cited by 10) | Negroes | 47.6% |
| 7. | Nakano et al(cited by 10) | Chinese | 48.1% |

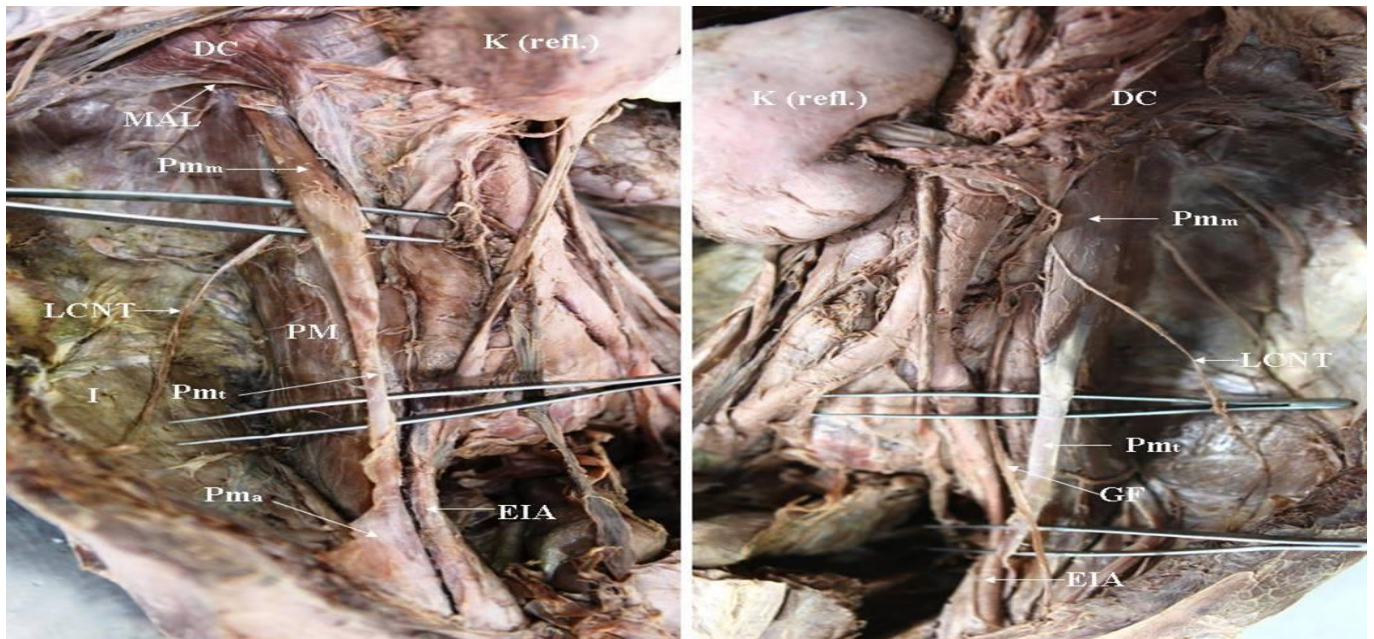


Figure 1a: DC-diaphragmatic crura, MAL-medial arcuate ligament, K(refl.)-kidney reflected, Pm(m,t,a)-muscular belly, tendinous part, aponeurotic part of Psoas Minor, PM- Psoas Major, LCNT- lateral cutaneous nerve of thigh, I- iliacus, EIA- external iliac artery.

Figure 1b: DC-diaphragmatic crura, K(refl.)-kidney reflected, Pm(m,t)- muscular belly, tendinous part of Psoas Minor, GF-genitofemoral nerve, LCNT- lateral cutaneous nerve of thigh, EIA- external iliac artery.