MORPHOLOGY OF PSOAS MINOR MUSCLE - REVIEWED

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ABSTRACT: Psoas minor (PM) muscle belongs to the category of vestigial muscles. It is large in size in all those quadrupeds that brachiate and leap or run at very fast speed. None of these functions being required in bipedal, plantigrade man the muscle has receded during evolution; hence it is present only in 40-60% population. Apart from racial variations, a large number of morphological variations of this muscle have been described in the literature. The present study has been conducted in 20 cadavers. Psoas minor muscle was present bilaterally in 35% cases and unilaterally in 5% cases; overall incidence being 40%. Average length of fleshy belly was 7.85 cm that of tendon was 13.13 cm. Average maximum width of fleshy belly was 1.93 cm, and that of the tendon was 0.77cm. In most of the cases, muscle originated from the sides of bodies of T12 & L1 vertebrae & their intervening intervertebral disc. In few of them, origin extended to the sub diaphragmatic fascia & the medial arcuate ligament (Fig.1a). Tendon of PM flattened out at insertion on iliopectineal line & blended with iliopsoas fascia (Fig.2a, 3a). The expansion of tendon into this fascia might be serving some special functions, hitherto fore unappreciated. We also found Psoas accessorius (PA) muscle which was described for the first time by Joshi et al. (2010)[1], in 15% cases unilaterally only on the left side. In one case, PA showed a bilamellar arrangement of muscle fibres.
KEY WORDS: Psoas accessorius, Psoas minor, Psoas major, Morphology.

INTRODUCTION: Psoas minor is a slender muscle of posterior abdominal wall, having short fleshy belly and long tendon, lying anterior to Psoas major muscle. It is found to be absent in 40% individuals. It arises from the sides of bodies of T12 and L1 vertebrae and their intervening intervertebral disc. It is inserted by a long flat tendon attached to iliopectineal eminence, pectineal line and iliac fascia. It is innervated by ventral ramus of L1 spinal nerve. It is a weak flexor of trunk.[2]

It is well developed and constant in those animals who brachiate or run at very fast speed, where it is used to flex the pelvis on the trunk.[3, 4] It is active in cats when they arch their back.[5] In humans it has clinical significance in sports medicine, especially in football players[6] where the muscle often gets strained while playing with feet off the ground. Racial and morphological variations have been reported.[7] As quoted by Guerra et al. (2012)[8], in 1988 Gardener et al.[9] reported its insertion by a thin tendon, into iliopectineal eminence and arcuate line, inconstant insertion into iliac fascia and pectineal ligament. Further, Guerra et al. (2012)[8] have stated that according to Testut and Latarjet (1976)[10], it is not rare to find this muscle reduced to one or two tendons. Hence the present study has been undertaken to review the morphology of this vestigial, yet significant muscle.

MATERIALS & METHODS: 20 embalmed cadavers were used for the present study. Posterior abdominal wall muscles were exposed after removal of abdominal viscera. Presence of Psoas minor muscle was noted. The muscle was cleaned from its origin to insertion. Length and maximum width of its fleshy belly and tendon were measured with the help of digital vernier caliper, thread and

scale. Observations were tabulated. Variations of Psoas minor muscle, if any, were noted and photographed.

OBSERVATIONS: In the present study, Psoas minor muscle was present in 40% (8/20 cases) cadavers studied: Bilateral in 35% (7/20 cases); & Unilateral in 5% (1/20 cases). Psoas accessorius (PA) was found to be present unilaterally in 15 % (3/20) cases.

The Muscle belly, in all the cases originated from the sides of bodies of T12 &L1 Vertebrae and the intervening intervertebral disc. Of these, in three muscle bellies (Fig. 1a) were bulky, where the origin extended to subdiaphragmatic fascia and medial arcuate ligament. Tendon, in all the cases, was long, flattened out at the insertion and blended with iliopsoas fascia; some aponeurotic fibres inserting over iliopectineal line (Fig.3a.). The Average length of fleshy belly was 7.85cm (Rt-7.56cm, Lt-8.14cm) and that of tendon was 13.13cm (Rt-13.56cm, Lt-12.7cm) (Table-1&2).The average maximum width of fleshy belly was1.93cm (Rt-1.96cm, Lt-2.14cm) and that of tendon was 0.77cm (Rt-0.76cm, Lt-0.78cm) (Table-1&2).

Wide variations were noted in the morphology of the muscle. Tendon in some cases was very thin (Fig.2b), while in few others it was broad (Fig.2a). The tendon lies close to genitofemoral nerve (Fig.3b), lying on the psoas major muscle. In one cadaver (Fig.3a.), the main tendon turned medially to merge with obturator fascia, while its shiny aponeurotic fibres were seen in fascia iliaca as well.

In one instance, on the left side, the main muscle is getting additional musculotendinous slips from the sides of bodies of L3, L4, L5 vertebrae. Psoas accessorius muscle was originating from the deep surface of left Psoas minor tendon to spread out as fleshy mass on anterior surface of Psoas major muscle (Fig.4c).

In two cases, it splits into a superficial layer which joins the deep surface of fascia iliaca as ribbon like bands. This superficial stratum could be gently dissected from the overlying fascia. The direction of superficial fibres is downwards and laterally forming an acute angle with the fibres of deep stratum .The deeper stratum runs on the anterior surface of Psoas major (Fig.4b) & both escape through the pelvifemoral space.

DISCUSSION: Gardener et al. (1988)[9], as reported by Guerra[8] , stated that insertion of Psoas minor muscle is by a thin tendon into the iliopectineal eminence, arcuate line, the iliac fascia & pectineal ligament. In the present study, tendon, in all the cases, was long, flattened out at insertion and blended with iliopsoas fascia; some aponeurotic fibres inserting over iliopectineal line (Fig.3a.). Guerra et al. (2012)[8] have reported the presence of Psoas minor muscle in 13/22(59%), of which, in 4 fetuses Psoas minor tendon passed posteriorly to the crural arch & then into the pectineal line of femur. In the present study conducted on adult cadavers, it is found in 40%cases. Incidence of Psoas minor, found in present study, matches with that reported by Kendal et al.[11], & Wood jones et al.[12] (Table-4). In the same table, we can see that the incidence reported by Snell RS[13] is 60% & by Kraychete et al.[14] is 30% only. Thin Tendon of Psoas minor, may be mistaken for genitofemoral nerve.[15] In a study done by Saib (1934), which has been referred to by Hanson P et al. (1999)[7], Psoas minor muscle was reported to be present in 50% in Orientals, 43% in whites & 33% in blacks. Hanson P et al. (1999)[7] studied Psoas minor in blacks & whites, wherein it was found to be present in 2/21 (9%) in blacks & 87% in whites on both sides. In blacks, muscle appeared as slight

thickening of fascia surrounding psoas major. In contrast, in whites, it was a well defined muscle anterior to & separate from Psoas major fascia.

Psoas minor is found to be consistently absent in those with Trisomy 18. Higher frequency of muscle anomalies in aneuploid is due to the delayed developmental processes in them. Muscles affected in them are generally those that differentiate rather late during embryonic development.[16] Psoas minor syndrome, which is caused by tense muscle & tendon, is attributed to its failure to keep pace with growth of pelvis. It leads to pain in corresponding iliac fossa, aggravated by palpation of taut tendon. Tenotomy gives relief. On right side, it needs to be differentiated from Appendicitis.[17] Psoas muscle strain occurs in athletes like professional Golfers & mostly in football players while playing with feet off the ground. It leads to pain in inguinal region extending towards the abdominal wall & testis, interfering with their ability to run, or jump.[6]

Reviewing the Literature, it is observed that, Joshi et al (2010)[1] reported the presence of Psoas accessorius in 25% cases, while in the present study it is found only in 15% cases. An interesting morphological variation observed was that the fibres of psoas accessorius arising from deep surface of tendon of psoas minor muscle split into a superficial & a deeper layer. The superficial lamina joined the deep surface of fascia iliaca as ribbon like bands. This superficial stratum could be gently dissected from the overlying fascia (Fig.4b.). The direction of superficial fibres was downwards and laterally forming an acute angle with the fibres of deeper stratum. The deeper stratum ran on the anterior surface of Psoas major & both the strata escaped through the pelvifemoral space. As described by Joshi et al. (2010)[1], Psoas accessorius continued on the superficial surface of the Psoas major muscle right upto its insertion. The muscle can be visualized by USG, CT & MRI.[18]

CONCLUSION: Present study, conducted in 20 cadavers, showed the presence of Psoas Minor muscle in 40% cases (8/20 cases): Bilateral in 35% (7/20 cases); & Unilateral in 5% (1/20 cases). Only 15% cadavers showed the presence of psoas accessorius unilaterally on the left side. In some cases it was present as superficial and deep lamina.

Inspite of being a regressive muscle, fleshy belly with a broad origin extending to subdiaphragmatic fascia & medial arcuate ligament was found in 15% cases. Wide variations at insertion were noted. Apart from its evolutionary significance, this muscle has clinical significance in sports medicine.[6]

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Table (1) -Psoas minor (Right side).

Sr. No.	Length of Fleshy Belly (cm)	Width of Fleshy belly (cm)	Tendon Length(cm)	Tendon Width(cm)
1	7	2	14	0.5
2	8.5	2.5	14.5	0.5
3	9	1.5	13	0.8
4	5.5	1.8	15	0.4
5	9	2	16	0.8
6	7	2	13	1.12
7	7	2	11.5	1
8	7.5	2	11.5	1
Average	7.56	1.72	13.56	0.76
Range	5.5 – 9	1.5 – 2.5	11.5 – 16	0.4 – 1.12

Table (2) – Psoas minor (left side).

Sr. No.	Length of Fleshy belly (cm)	Width of Fleshy belly (cm)	Tendon Length (cm)	Tendon Width (cm)
1	7	2	14	0.5
2	8	3.5	15.5	0.7
3	10	2.5	13	1.0
4	6	2	15	0.5
5	7	2	9	1.3
6	10	2	10	1
7	9	1	13	0.5
Average	8.14	2.14	12.7	0.78
Range	6 - 10	1 -3.5	9 – 15.5	1 – 1.3

Table-3

Comparision of Right and Left Psoas Minor				
Side	Length of Fleshy Belly (cm)	Width of Fleshy belly (cm)	Tendon Length (cm)	Tendon width (cm)
Right	7.56	1.72	13.56	0.76
Left	8.14	2.14	12.7	0.78

Table-4

Reported incidence of psoas minor			
S.N.	Researcher	Year	Incidence%
1	Kendal et.al[11]	1953	45
2	Wood jones et.al[12]	1993	40
3	Snell RS[13]	1999	60
4	Kraychete et.al[14]	2007	30
5	Joshi.et al[1]	2010	30
6	Guerra. D.R. et.al[8]	2012	59.09
7	Present	2013	40

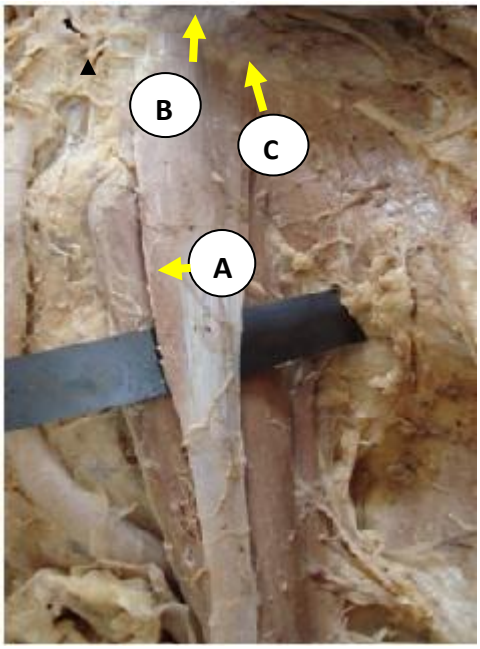

Fig 1a. Bulky Psoas minor
(A) origin extending to (B)- Subdiaphragmatic fascia & (C)- Medial arcuate ligament

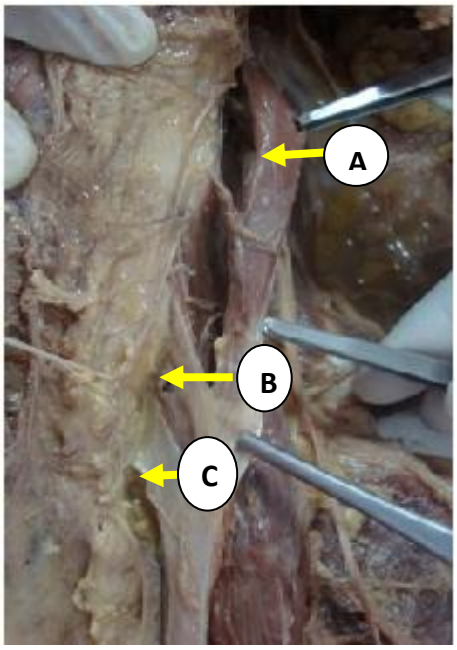

Fig 1b. Psoas minor
(A) getting additional musculotendinous slips (B) & (C) from sides of bodies of L3, L4 & L5 vertebrae.

Fig 2a. Broad Tendon of Psoas minor.

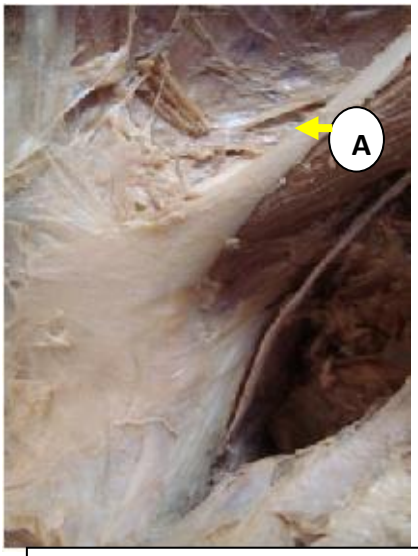

Fig 2b. Thin Tendon of Psoas minor.

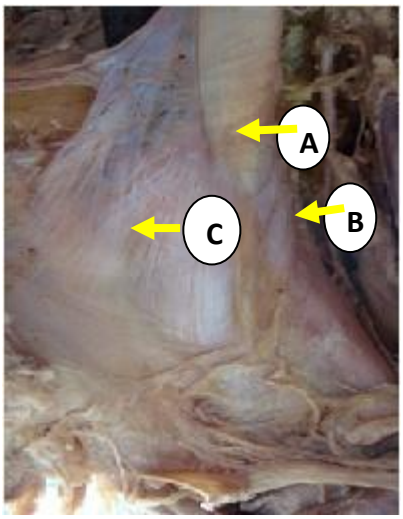

Fig 3a. Psoas minor Tendon
(A) Merges with obturator fascia
(B) Medially, & fascia iliaca
(C) Laterally.

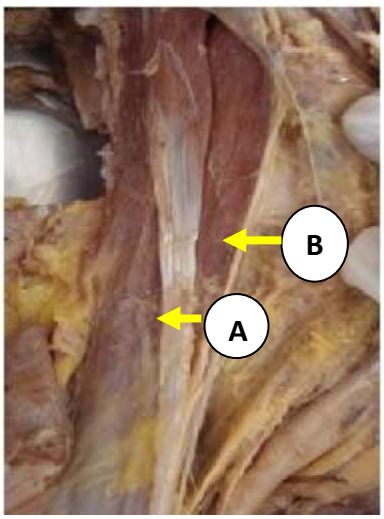

Fig 3b. Psoas minor Tendon
(A) related to Genitofemoral Nerve (B).

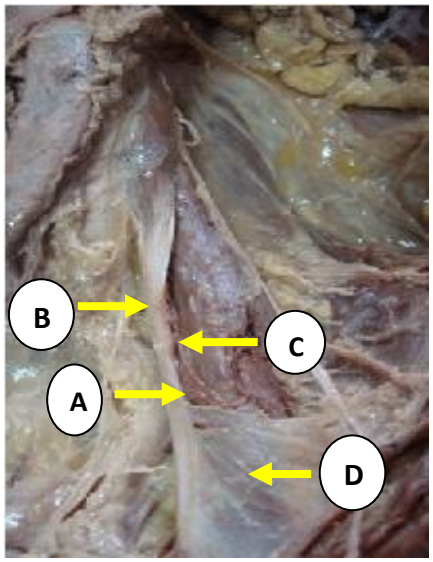

Fig 4a. Psoas accessorius (A), covered by iliac fascia (D), arising from deeper surface of Psoas minor Tendon (B) runs on the anterior surface of Psoas major (C).

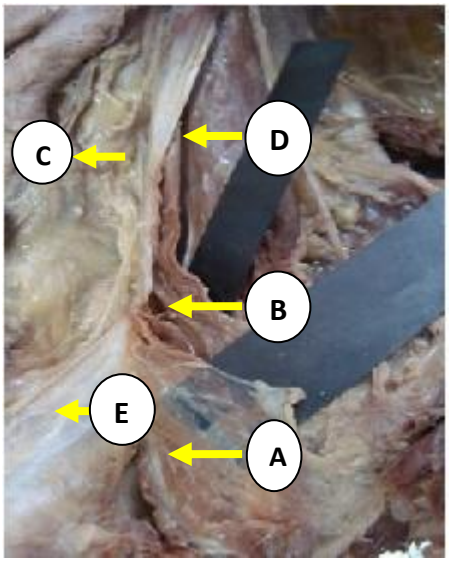

Fig 4b.Psoas accessorius splits into Superficial lamina (A) & Deeper lamina (B). PA arises from deeper surface of Psoas minor Tendon (C). It runs on Psoas major (D). (E) is retracted iliac fascia.

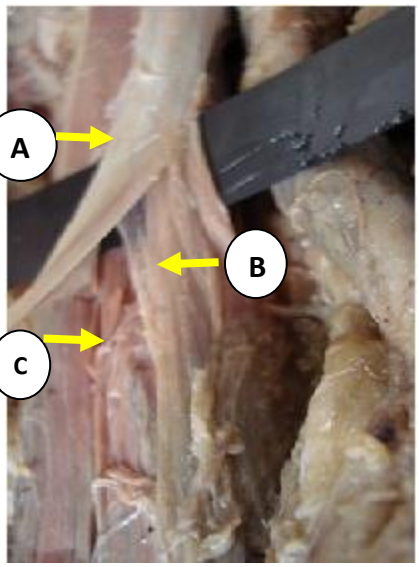

Fig 4c. Psoas accessorius (B) Arising from deeper surface of Psoas minor Tendon (A), runs on the surface of Psoas major (C).

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