



Original Research Article

A cadaveric study on the morphology of psoas minor and psoas accessorius muscles

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ABSTRACT

Introduction: In the human body, one of the most variable muscle groups is the psoas muscle group. The psoas muscle group is composed of long fusiform muscles – major, minor and accessorius, and out of these the psoas major muscle is present in all individuals.

Aim: Reporting the gross anatomic detail of the psoas minor and psoas accessories muscles is the main aim of our study.

Materials and Methods: 25 formalin preserved and embalmed cadavers were available for our study. We took the different in-situ measurements with the help of a digital vernier caliper.

Results: We found psoas minor muscle on the right side in 5 (20%) cadavers and on the left side in 4 (16%) cadavers. While in 3 cadavers (12%), psoas minor was present bilaterally. So out of 25 cadavers, psoas minor muscle was observed in 12 (48%). Psoas accessorius was present in just 1 cadaver (4%).

Discussion: This psoas minor and psoas accessorius muscle has both evolutionary as well as clinical significance and importance.

Conclusion: The morphology of this muscle is very important for anatomists, surgeons, kinesiologists and physiotherapists from its clinical point of view.

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1. Introduction

In the human body, one of the most variable muscle groups is the psoas muscle group. The psoas muscle group is composed of long fusiform muscles – major, minor and accessorius, and out of these the psoas major muscle is present in all individuals. However psoas minor muscle is considered a vestigial muscle just like palmaris longus and plantaris and is present in just 40-60% of human population. Psoas minor is a slender muscle and is mostly situated anterior to Psoas major muscle in the posterior abdominal wall. In primates like gibbons and siamang, this psoas minor is very well developed and acts as flexor of pelvis and thereby helping them in brachiating. In animals like jaguar that runs at a very high speed, this psoas minor muscle again is very bulky and well developed. With the evolution of

upright posture and gait in some primates including humans, it is found to disappear or becomes vestigial. When present in humans, its main action is weak flexion of trunk.

Mostly, it arises from the sides of T12 and L1 vertebral bodies and the corresponding intervertebral disc and has a long tendinous insertion at iliopectineal eminence, pectineal line and iliac fascia. In few instances, it arises from subdiaphragmatic fascia and medial arcuate ligament. The nerve supply of psoas minor comes from anterior rami of the L1 nerve.

Reporting the gross anatomic detail of the psoas minor and psoas accessories muscles is the main aim of our study.

2. Materials and Methods

The present study was carried in the Department of Anatomy, All India Institute of Medical Sciences, Raipur (Chhattisgarh), over a period of one and a half year starting

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from January 2019 to June 2020. 25 formalin preserved and embalmed cadavers were available for our study. Dissection of posterior abdominal wall was done as per the instructions given in Cunningham's Manual of Practical Anatomy. We have exposed the muscles of the posterior abdominal wall by removing their fascial coverings. We did the inspection thoroughly and bilaterally while searching for psoas minor and psoas accessories muscles. Once we found the desired muscles, we cleaned them starting from its point of origin up to its point of insertion.

We took the different in-situ measurements with the help of a digital vernier caliper. We have measured the length of muscle belly from its cranial origin to its musculotendinous junction. And we measured the length of tendon from its musculotendinous junction to its caudal attachment to the pelvis. All these measurements were noted and tabulated. Similarly, we have measured the maximum width of muscle belly and tendon with the help of digital vernier caliper and all the measurements were noted and tabulated.

3. Results

We found psoas minor muscle on the right side in 5 (20%) cadavers as shown in Figure 1 (a) and on the left side in 4 (16%) cadavers as shown in Figure 1(b). While in 3 cadavers (12%), psoas minor was present bilaterally as shown in Figure 1(c). So out of 25 cadavers, psoas minor muscle was observed in 12 (48%). Psoas accessorius was present in just 1 cadaver (4%).

We calculated the mean length of muscle belly of psoas minor on the right side was 7.9cm while the mean length of muscle belly of psoas minor on the left side was 7.6cm (Tables 1 and 2). The mean width of muscle belly on the right side was 1.8cm and on the left side was 1.6cm. (Tables 1 and 2)

Also the mean length of tendon of psoas minor on the right side was 12.6cm while the mean length of tendon of psoas minor on the left side was 11.9cm (Tables 1 and 2). The mean width of tendon of psoas minor on the right side was 0.8cm and on the left side was 0.6cm. (Tables 1 and 2)

In one cadaver, psoas accessorius muscle was present on the right side (Figure 1c). It had a tendinous origin and insertion. The length and width of muscle belly of psoas accessorius were 6.2cm and 1.4cm respectively (Table 3). While the length and width of its tendon was 3.1cm and 0.3cm respectively (Table 3).

4. Discussion

The psoas minor muscle is an inconstant muscle and its presence in human body can be unilateral or bilateral with its caudal insertions at different anatomical points. The length of the tendon of this muscle is always more than that of the length of its muscle belly. We found the mean length

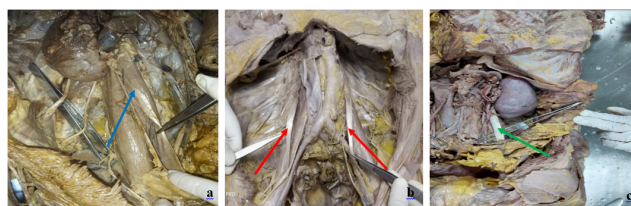


Fig. 1: (a). Psoas minor present on the right side and is indicated by blue arrow, (b). Psoas minor present bilaterally and is indicated by red arrow and (c). Psoas minor present on the left side and is indicated by green arrow.

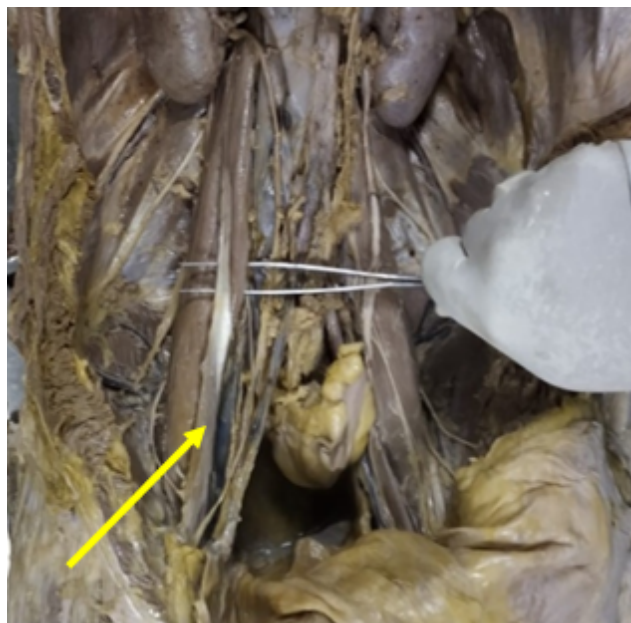


Fig. 2: Psoas accessorius present on the right side and is indicated by yellow arrow.

of the tendon of psoas minor muscle on the right side was 12.6cm and on the left side the mean length was 11.9cm. (Tables 1 and 2).

In our study, psoas minor muscle was present in 48%. Farias et al. in their study, found the psoas minor muscle to be present in 59% of the Brazilian population.¹ While Neumann et al. in their study which was conducted in US, found the psoas minor muscle to be present in 65.6% of the population.² In one population of India, Joshi et al. found this psoas minor muscle to be present in 30%.³ In another study conducted in India by Ohja et al., found this muscle in 26.66% population.⁴

The mean length of psoas minor muscle on the right side in our study was 20.5cm and on the left side was 19.5cm. Farias et al. reported a mean length of 23.93cm in their study conducted in Brazilian population while Neumann et al. in their study, found the mean length of this muscle to be 23.85cm in US population.^{1,2} As per Joshi et al. and Ojha et al. the mean lengths of this muscle in Indian population

Table 1: Morphometric analysis of Psoas minor muscles present on the right side.

S. No	Gender	Total length (cm)	Muscle belly length (cm)	Muscle belly width (cm)	Tendon length (cm)	Tendon width (cm)
1	M	19	7.2	1.6	11.8	0.5
2	F	20.9	8.1	2.2	12.8	0.6
3	M	19.2	7.6	1.7	11.6	1.1
4	F	22.1	8.7	2.3	13.4	1.2
5	F	22.1	8.2	1.8	13.9	0.8
6	F	20.1	7.8	1.5	12.3	0.6
7	M	21.8	8.6	2.1	13.2	1.3
8	M	18.6	6.9	1.4	11.7	0.4
Mean	-	20.5	7.9	1.8	12.6	0.8

Table 2: Morphometric analysis of Psoas minor muscles present on the left side.

S. No	Gender	Total length (cm)	Muscle belly length (cm)	Muscle belly width (cm)	Tendon length (cm)	Tendon width (cm)
1	M	18.7	7.2	1.5	11.5	0.6
2	M	20.2	8.1	2.0	12.1	0.9
3	F	19.5	7.5	1.7	12.0	0.5
4	M	19.4	7.6	1.8	11.8	0.5
5	F	20.8	8.1	1.7	12.7	0.7
6	M	19.1	7.3	1.5	11.8	0.8
7	M	18.8	7.2	1.3	11.6	0.5
Mean	-	19.5	7.6	1.6	11.9	0.6

Table 3: Morphometric analysis of Psoasaccessorius muscle.

S.No	Gender	Total length (cm)	Muscle belly length (cm)	Muscle belly width (cm)	Tendon length (cm)	Tendon width (cm)
1	M	9.3	6.2	1.4	3.1	0.3

Table 4: Comparison between the length of psoas minor muscle among males and females.

Gender	Mean total length (cm) Right side	Mean total length(cm) Left side
M	19.7	19.2
F	21.3	20.2

were 23.75cm and 22.12cm respectively.^{3,4}

In our study, mostly the fibers of psoas minor muscle were found to be attached cranially to the bodies of T12 and L1 vertebrae and the corresponding intervertebral discs. In 2 cadavers, the fibers of psoas minor muscle were seen to arise from subdiaphragmatic fascia and medial arcuate ligament. And in only one cadaver, the fibers of psoas minor muscle were found to be attached to the body of L2 vertebra. Garg and Chauhan in their study reported that the muscle fibers of psoas minor were found to be originating from the crus of the diaphragm. They too in their study found that the fibers of psoas minor muscle were seen to arise from subdiaphragmatic fascia and medial arcuate ligament.⁵

In our study, we have noticed in most of the cadavers, this psoas minor was inserted as a slender tendon into the lower part of fascia present over psoas and iliacus muscles. And then it was attached to the arcuate line of ilium medially and with the iliac fascia to the inguinal ligament laterally. In one cadaver, the tendon was found to be attached caudally

to the iliopectineal eminence and pecten pubis. Guerra et al. in their study found variations in the distal attachment of tendon of psoas minor muscle. They observed that the tendon could insert into the pectineal line of the femur, lesser trochanter with the iliopsoas, neck of the femur, the iliac fascia, the arched line, the inguinal ligament or the pectineal ligament.⁶ In few studies, bifurcation of the psoas minor tendon was noted where the aberrant band was found to be attached onto the synchondrosis between the fifth lumbar vertebra, iliopectineal line and sacrum.⁷ Ojha et al. in their study found that the tendon inserted near the iliopectineal eminence and got merged with the obturator fascia medially and the iliac fascia laterally.⁴ Gardener et al. also observed that the insertion of psoas minor muscle was by a thin tendon into the iliopectineal eminence, arcuate line, the iliac fascia and pectineal ligament.⁸

Out of 12 cadavers, where we found psoas minor muscle, 7 (58.3%) were male and 5 (41.7%) were female cadavers (Tables 1 and 2). So its prevalence was found to be more

among male population. Seib in his study concluded that the muscle was seen less frequently in females.⁹ Whereas Bergman et al. found that it was more frequently absent in males. In the present study, in one cadaver where we observed psoas accessorius muscle on the right side was that of a male as shown in Figure 2. The total length of psoas accessorius was 9.3cm and it arises from one tendon of psoas minor muscle and then it was found going downwards and lies anterior to psoas major muscle. After that it was attached caudally to the iliopectineal eminence and pecten pubis.

We have found in our study that the mean total length of psoas minor muscle on the right side in male cadavers was 19.7cm and in female cadavers was 21.3cm (Table 4). And also, the mean total length of psoas minor muscle on the left side in male cadavers was 19.2cm and in female cadavers was 20.2cm (Table 4). We have observed that the psoas minor muscle was slender and had longer tendinous insertion in female cadavers.

This psoas minor and psoas accessorius muscle has both evolutionary as well as clinical significance and importance. When present, eventually they become stiff and firm and also become less flexible. And finally results in psoas minor syndrome where retroperitoneal neurovascular structures are compressed and gives rise to the symptoms like lower quadrant abdominal pain which mimics that of appendicitis or diverticulitis. In sportspersons, this syndrome can severely affect their performances because they are unable to perform various exercises like jumping, hopping and leaping. The treatment of choice is tenotomy, which alleviate the symptoms.

5. Conclusion

In our study it has been finally concluded that although psoas minor muscle is vestigial and inconstant and not frequently observed in human population but still its presence is noted in 48% population. And the morphology of this muscle is very important for anatomists, surgeons, kinesiologists and physiotherapists from its clinical point of view. Further studies are required to fully explain the consequences of these psoas minor variants on clinical function and pathologies.

6. Source of Funding

None.

7. Conflict of Interest

None.

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