



## INTRAABDOMINAL VARIATION IN THE COURSE OF THE ILIOINGUINAL NERVE IN SUDANESE SUBJECTS

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### ABSTRACT

The variations in the formation and distribution of the ilioinguinal nerve are the cause of the failures of the ilioinguinal block and the difficulties at interpreting the ilioinguinal nerve syndrome. In order to identify its variations, we dissected 154 inguinal nerves of adult Sudanese subjects. **Objectives:** - To find out the prevalence and incidence of variation in the projection of ilioinguinal nerve. **Material and methods:** - The study was conducted in Khartoum state – Sudan on 77 formalin embalmed cadavers which were dissected bilaterally to expose ilioinguinal by transperitoneal approach, in Sudanese male cadavers, age ranging from 24-56yaers. **Results:** - Out of total 154 dissected ilioinguinal nerves, a double nerve was observed in 13/154 (8.44%) cadavers. This variety was seen in 8/77 (10.4%) on the left side, and in 5/77 (6.5%) on the right side.

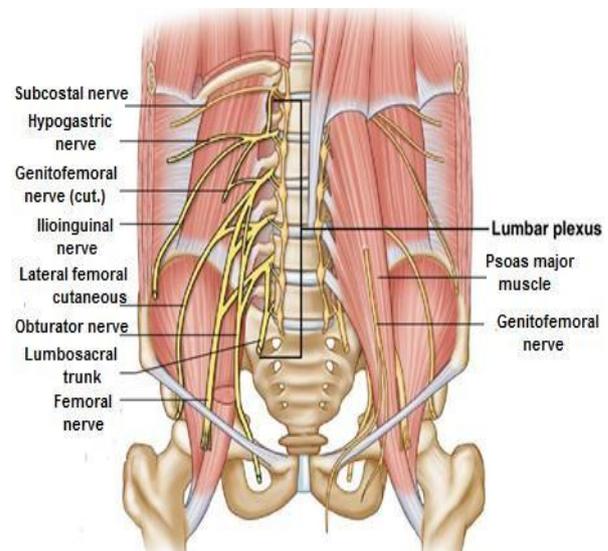
### INTRODUCTION

The posterior abdominal wall contains the origin of lumbar plexus, numerous autonomic plexus and ganglia, which lie close to the abdominal aorta and its branches.<sup>[1]</sup>

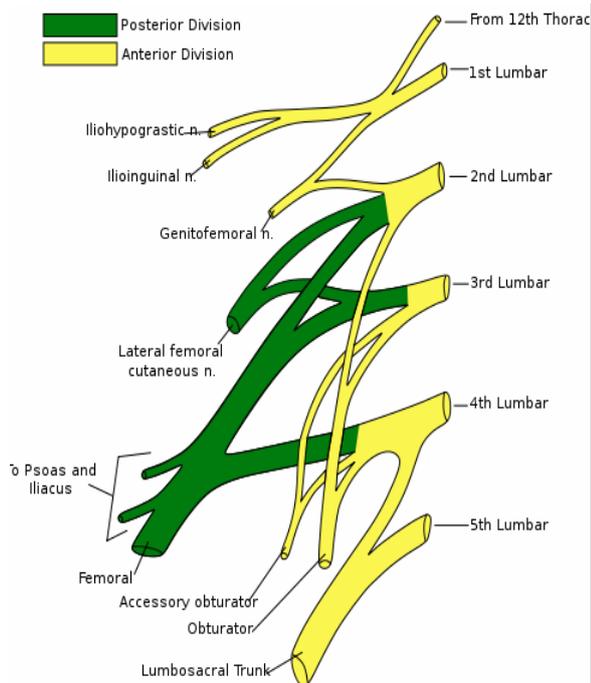
The lumbar plexus originates from the ventral rami of the L1–L4 nerve roots and projects laterally and caudally from the intervertebral foramina, posterior to the psoas major muscle. A communicating branch from the T12, also known as the subcostal nerve, often joins the first lumbar nerve. The L2–L4 ventral rami first bifurcate into an anterior and posterior primary division. The T12 and L1 nerves and the L2–L4 anterior primary divisions supply muscular branches to the psoas major and quadratus lumborum. Both primary divisions then enter the lumbar plexus and give rise to six peripheral nerves. Within this plexus, the L1 nerve splits into a cranial and caudal branch. The cranial branch bifurcates into the iliohypogastric (IHN) and Ilioinguinal nerves (IIN), the former also formed by the subcostal nerve in people where this nerve contributes to the lumbar plexus.

The caudal branch of the L1 nerve unites with the anterior division of the L2 nerve to form the genitofemoral nerve. The anterior divisions of the L2–L4 roots form the obturator nerve. The lateral femoral cutaneous nerve arises from the posterior divisions of the

L2 and L3 roots; the posterior divisions of L2, L3 and L4 join to create the femoral nerve (figure 1 and 2).<sup>[2]</sup>



**Figure 1: The Lumbar plexus.**



**Figure 2: Schematic of Lumbar plexus.**

The current study will endow with knowledge on the variation in the intra-abdominal course of ilioinguinal nerve which will assist surgeons in avoiding injury to this structure in various abdominal surgeries.

The ilioinguinal nerve originates from ventral ramus of the first lumbar spinal segment and emerges from the lateral aspect of upper part of psoas major muscle just below the iliohypogastric nerve, passes obliquely across quadratus lumborum and the upper part of iliacus and enters transversus abdominis muscle near the anterior end of the iliac crest. It pierces the internal oblique muscle and supplies it and then traverses the inguinal canal. It emerges with the spermatic cord from the superficial inguinal ring to supply the proximal medial skin of the thigh and the skin over the root of the penis and upper part of the scrotum in males, or the skin covering the mons pubis and the adjoining labium majus in females.<sup>[3]</sup>

## MATERIAL AND METHODS

A cadaveric study which was conducted in the department of anatomy of several faculties of medicine in Khartoum state-Sudan during the period of May 2015 to August 2017 on 154 inguinal nerves which were embalmed in formalin, cadavers ranging from 24-56 years, dissection performed bilaterally to observe formation, emergence and distributions of the nerve, dissection was completed by anatomist by making a horizontal incision which was made from anterior superior iliac spine (ASIS) on aponeurosis of external oblique muscle to linea alba in midline and from this point vertically down to pubic symphysis. The triangular flap of external oblique aponeurosis was reflected laterally and inferiorly to expose inguinal ligament, inguinal canal with its contents. The nerve was exposed

through anterior approach after removal of peritoneum and abdominal viscera. The nerve has been identified on the lateral border of psoas major muscle. The muscles of the posterior abdominal wall were exposed by removing their fascial coverings and the psoas major muscle was detached from the intervertebral discs and vertebral bodies, the removal of psoas from the transverse processes of the lumbar vertebrae was carefully completed, disentangling the ventral rami of the nerve from its substance, the nerve and its branches was exposed. All possible formation of the nerve was photographed. The observations so made were recorded and compared with standard texts as well as with accessible literature.

## RESULTS

Out of 77 left ilioinguinal nerve there were eight double nerves, 6/77 (7.8%) of the double ilioinguinal nerves originates as a single trunk from the first ventral lumbar spinal segment (Figure 4, 5), then divided in two medial sensory and lateral motor, the sensory branch continue in to the inguinal canal to exit through superficial inguinal ring, it supply sensory branches to upper medial thigh, root of penis, and scrotum (Figure 6). The motor branch innervates muscles of anterior abdominal.

In the remainder 2/77 (2.6%) observed left double nerve, the ilioinguinal nerve arose as two nerve trunks (Figure 7), thin inferior branch which will continue to the inguinal canal as a sensory branch, and thick superior branch which was the motor branch to anterior abdominal wall muscle.

In contrary, the right paired ilioinguinal nerves were five in number (Figure 8), they were also of two types, in three dissected cadavers (3.9%) they were originated from the common root which was formed by the ventral ramus of first lumbar spinal segment (Figure 9), then this common root was divided in to superior and inferior branches. Both superior and inferior branches ilioinguinal nerves were coursing parallel to each other as separate nerves beginning from their origin. Both were found anterior to the quadrates lumborum. The superior branch was continued to the inguinal canal as a sensory branch, while the inferior branch which was ended at the iliac origin of transverses abdomens and internal oblique muscles as a motor branch for both muscles (Figure 10).

Whereas, in the remainder 2/77 (2.6%) variety of the right pair ilioinguinal nerve, they were originated as two nerves from the ventral ramus of the first lumbar spinal segment. Then the two branches united before piercing transversus abdomens muscle to form single nerve, this single nerve was continue as normal ilioinguinal nerve (Figure 11).

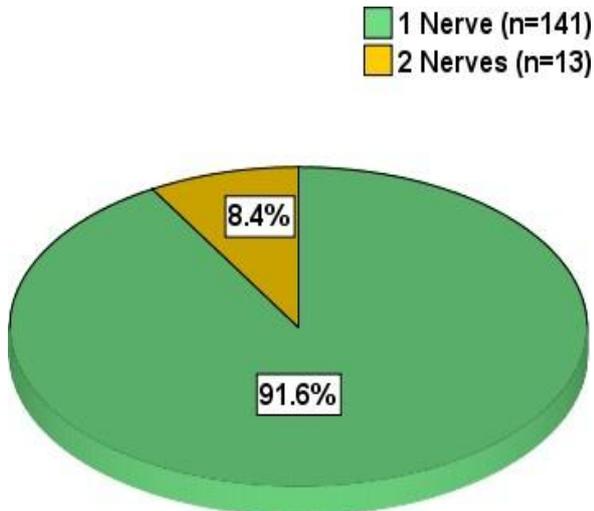


Figure 3: Number of the Ilioinguinal nerves isolated among the study group (n=154).

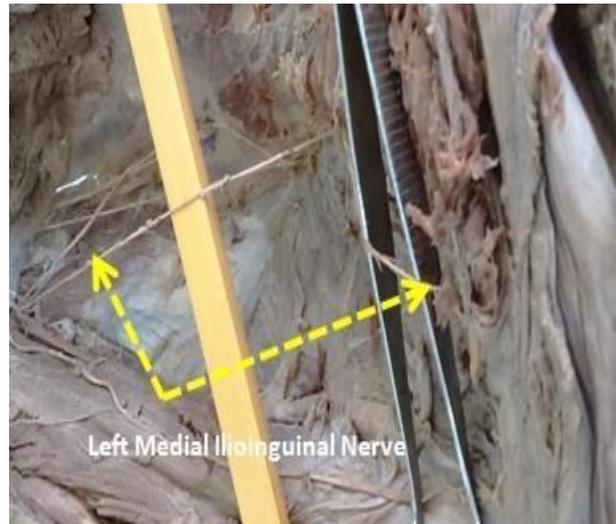


Figure 6: Left medial ilioinguinal nerve continue as sensory nerve to the inguinal canal.

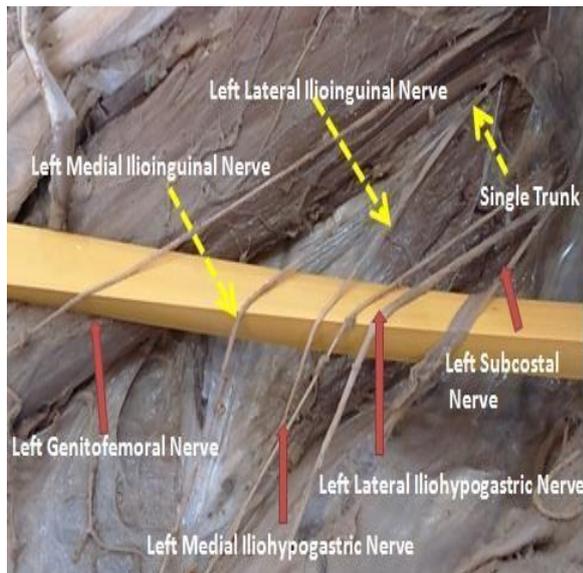


Figure 4: Left double ilioinguinal nerves originating from first lumbar spinal segment as a single trunk.

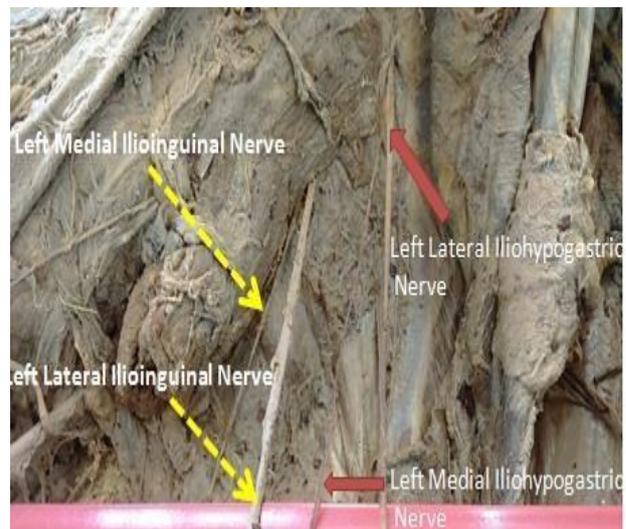


Figure 7: Left double ilioinguinal nerves originating individually from first lumbar spinal segment.



Figure 5: The course of the Left double ilioinguinal nerves.

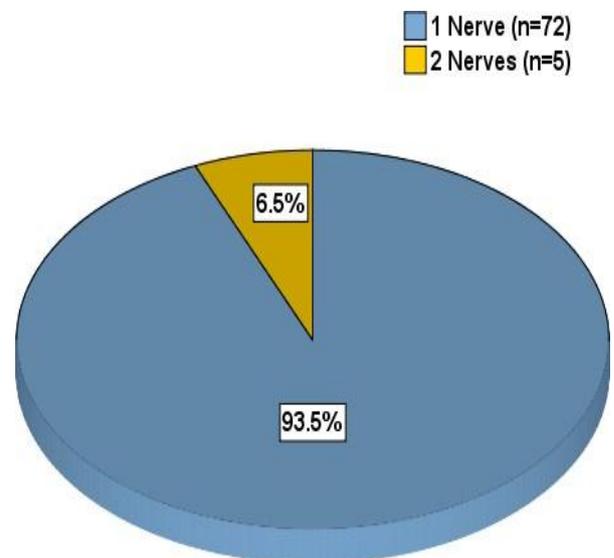
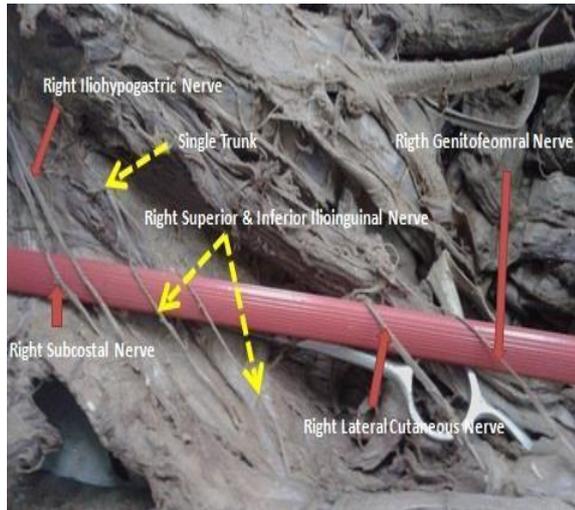
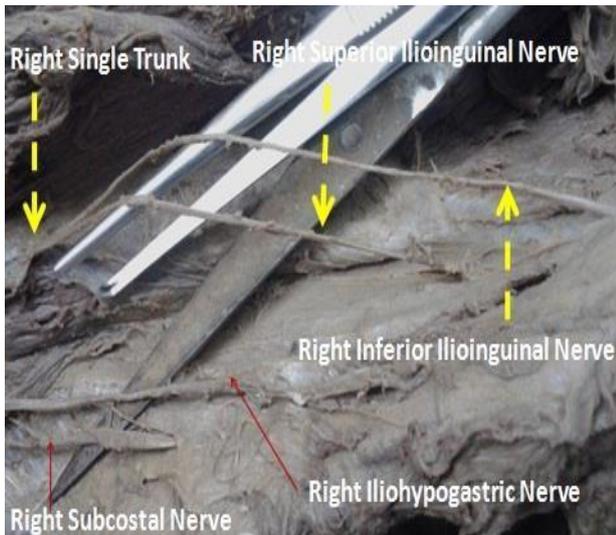


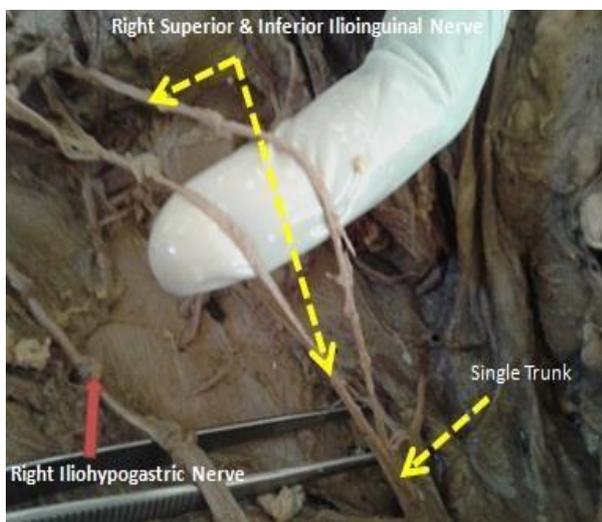
Figure 8: Number of nerves in the right side of the studied cadavers (n=77).



**Figure 9: Right double ilioinguinal nerves originating from first lumbar spinal segment as a single trunk.**



**Figure 10: Right inferior Ilioinguinal nerve continue in to the inguinal canal.**



**Figure 11: Right double ilioinguinal nerves arose as separate origin from first lumbar spinal segment and union of the two nerves to form single trunk.**

**Table 1: Number of nerves in the right side versus left side among study group (n=154).**

The side	No. of nerve		Total	P value
	Single	Double		
Right	72 (46.8%)	5 (3.2%)	77 (50%)	<b>0.56</b>
Left	69 (44.8%)	8 (5.2%)	77 (50%)	
<b>Total</b>	<b>141</b> <b>(91.6%)</b>	<b>13</b> <b>(8.4%)</b>	<b>154 (100%)</b>	

**DISCUSSION**

The lumbar plexus is a network of nerves supplying the lower limb and is located within the substance the psoas major muscle.<sup>[4]</sup> The detailed anatomy of lumbosacral plexus was first described by Longnecker<sup>[5]</sup> and the variations in its formation and position were then presented by Hollinshead.<sup>[6]</sup>

Selda Yıldız et al studied 17 cadavers and reported double ilioinguinal nerve bilaterally in (5.9%).

Uzmans el et al reported paired ilioinguinal nerve on the right side of a female cadaver.

Sushma R Kotian et al, Assane Ndiaye et al reported double ilioinguinal nerve in (2%) and (1%) respectively.

In our study a double nerve was observed in 13/154 (8.44%) cadavers. This variety was seen in 8/77 (10.4%) on the left side and in 5/77 (6.5%) on the right side.

**Table 2: Reported incidence of double IIN in literature.**

Study	Year	Regions	No.	%
SeldaYıldız et al. <sup>[7]</sup>	2012	34	2	5.9
Uzmansel et al. <sup>[8]</sup>	2006	Case report	1	–
Sushma RK. et al. <sup>[9]</sup>	2015	50	1	2
AssaneNdiaye et al. <sup>[10]</sup>	2010	100	1	1
Current study	2017	154	13	8.4

**CONCLUSION**

The lumbar plexus is composed of complex and variable structures interrelated to their surroundings and any injury to them may also involve the surrounding structures. The present study revealed basic anatomical knowledge concerning the origin and variation in the ilioinguinal nerve. The results of the study may be beneficial for clinicians treating patients with lumbar plexopathies and anesthesiologists performing successful block in the lumbar plexus.

Variations in the intra-abdominal course of ilioinguinal nerve should be known to surgeons during various lower quadrant surgeries. It could be a prospective cause of ilioinguinal nerve entrapment syndrome.

These results showed the high variability of the emergence of the ilioinguinal nerve. This also helps to understand the high failure rate of single injection

technique of ilioinguinal nerve block given specially for pediatric age group patients undergoing groin surgery.<sup>[16]</sup> This further, reinforces the use of imaging techniques like ultrasonography for visualization of ilioinguinal as an alternative to the 'blind' standard techniques of ilioinguinal nerve block in pain medicine and anesthetic practice.

Thus the knowledge of lumbar plexus formation and its variations are useful for surgeons, not only in surgical procedures, but also in diagnosing various clinical conditions associated with it, like referred pain, psoas abscess and hip joint diseases etc.

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