Lumbosacral Plexus — Anatomy and Nerves

See online here

In the second part of the article about the spinal cord and peripheral nervous system, the lumbosacral plexus is discussed. Aside from that, medical students receive an insight into some review questions.

The first part can be found here.

Lumbosacral Plexus

The lumbosacral plexus is formed by the anterior rami of the spinal segments T12 - S4 to supply the lower limb. The lumbosacral plexus can be divided into the lumbar plexus, which innervates the ventral and upper half, and the sacral plexus, which mainly innervates the dorsal side.
Lumbar Plexus
The **lumbar plexus** is composed of segments **Th12 – L4** and is located next to lumbar spine behind the **psoas major** muscle. In addition to the short nerves leading to the hip muscles, it includes the following major nerves:

- **Iliohypogastric nerve:** Th12 – L1
- **Ilioinguinal nerve:** Th12 – L1
- **Genitofemoral nerve:** L1 – L2
- **Lateral cutaneous nerve of the thigh:** L2 – L4
- **Femoral nerve:** L1 – L4
- **Obturator nerve:** L2 – L4

**Tip:** For memorizing the branches of the lumbar plexus, you can use the following mnemonic: **Indians In Georgia Love Fresh Oranges!**
Iliohypogastric Nerve

The **iliohypogastric nerve** proceeds obliquely lateral on the **quadratus lumborum muscle** and runs ventrally. It supplies motor innervation to the caudal portions of the **transverse abdominis** and the **internal oblique muscles** of the abdomen. It is further divided into **anterior cutaneous branch** and **lateral cutaneous branch** for the sensory innervation of the skin above and to the side of the inguinal ligament.

Ilioinguinal Nerve

It runs below the **iliohypogastric nerve**, leans against the abdominal wall and pierces through it at a variable spot to finally run medially at the level of the **inguinal ligament** and to pass through the external inguinal ring to the pubic symphysis and the scrotum or to the labia majora.
It also provides motor innervation to the caudal portions of the transverse abdominis and internal oblique muscles of abdomen and possesses as sensory branches the femoral branch supplying the upper and inner parts of anterior thigh, and anterior scrotal nerve supplying the anterior part of scrotum (or labium majus in females).

Genitofemoral Nerve

After it pierces through the psoas major muscle, the genitofemoral nerve is divided into the genital branch and the femoral branch:

The purely sensory femoral branch passes through the vascular lacuna in the area of the saphenous opening and supplies the skin below the inguinal ligament, whereas the genital branch accompanied by the spermatic cord or round ligament of uterus moves through the inguinal canal towards the scrotum (or labia majora in females), which it supplies with sensory innervation as it does the region of the medial thigh. It provides motor innervation to the cremaster muscle.

Lateral Cutaneous Nerve of the Thigh

The purely sensory lateral femoral cutaneous nerve supplies the lateral skin of the thigh. Its course passes first the psoas major muscle and then the muscular lacuna to finally break through the fascia lata.

Femoral Nerve

The femoral nerve is the longest nerve of the lumbar plexus. It runs between the psoas major muscle and iliacus muscle and reaches the muscular lacuna on the lateral side of femoral artery and vein.

Note: IVAN summarizes the position of the structures in the muscular lacuna: Inside Artery, Vein, Nerve!
Just below the inguinal ligament, there is a division of the nerves into sensory **anterior femoral cutaneous nerves** to supply the skin of the anterior thigh and into the **motor branches** that supply the following muscles:

- Iliopsoas muscle
- Pectineus muscle
- Sartorius muscle
- Quadriceps femoris muscle

The **saphenous nerve** is the sensory terminal branch of the femoral nerve that
courses along the femoral artery and vein and moves into the **adductor canal**. Finally, it follows the **great saphenous vein** to the medial side of the lower leg. Thus, it innervates the skin between the knee and foot on the medial side.

**Obturator Nerve**

The **obturator nerve** moves behind the **psoas major muscle** distally, leans against the wall of the pelvis and together with the **obturator artery**, it enters through the **obturator canal** to move to the inner thigh.

Before it divides into an anterior and posterior branch, which run distally in front of or behind the adductor brevis muscle and innervate the adductor muscles (**adductor longus, adductor brevis, gracilis, pectineus, and adductor magnus muscles**), it releases a branch for the innervation of the **obturator externus muscle**.

The anterior branch ends in the sensory **cutaneous branch**, which innervates an approximately palm-sized area at the distal end of the inner thigh.

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**Sacral Plexus**

*“Structures surrounding right hip joint” by Henry Gray. License: Public Domain*
The **sacral plexus** is composed of the segments **L4 – S4** and sits on the **piriformis muscle**. It provides short motor branches to supply the hip muscles and further consists of the following nerves, of which the most important ones are described below:

- **Superior gluteal nerve**: L4 – S1
- **Inferior gluteal nerve**: L5 – S2
- **Posterior femoral cutaneous nerve**: S1 – S3
- **Sciatic nerve**: L4 – S3
  - **Common peroneal (fibular) nerve**: L4 – S2
  - **Tibial nerve**: L4 – S3
- **Pudendal nerve**: S1 – S4

**Note:** For the branches of the sacral plexus there is another mnemonic, the first letter indicating the involved nerve: **Glittering Goldrings Keep Ireen Pretty!**

**Superior Gluteal Nerve**

The purely motor **superior gluteal nerve** follows the superior gluteal vessels and moves through the **suprapiriform foramen** to supply the **gluteus medius**, **gluteus minimus** and **tensor fascia lata** muscles.

Since these three muscles are primarily responsible for the **abduction** of the hip joint and the stabilization of the pelvis in the frontal plane, a lesion of the nerve (e.g. in case of an incorrectly performed **intramuscular injection**) causes the so-called **Trendelenburg’s sign**: When walking or standing on one leg, the pelvis tilts towards the healthy side resulting in a waddling gait called Trendelenburg gait or gluteal gait.
Demonstration of Trendelenburg’s sign

Inferior Gluteal Nerve

The also purely motor inferior gluteal nerve moves together with the inferior gluteal vessels, the sciatic nerve, posterior femoral cutaneous and pudendal nerves as well as the pudendal vessels through the infrapiriform foramen and innervates the gluteus maximus muscle. Damage to the nerve is rarer than that of the superior gluteal nerve and leads to severe limitations when standing up, stair climbing and jumping.

Coccygeal Nerve

- Nerves to levator ani and coccygeus (Sr, S4) >> Muscles of pelvic floor
- Anococcygeal nerve >> Skin between coccyx and anus

Posterior Femoral Cutaneous Nerve

The purely sensory posterior femoral cutaneous nerve passes through the foramen infrapiriform and innervates the dorsal side of the thigh. To supply the gluteal fold, it releases the inferior cluneal nerves.

Sciatic Nerve
The *sciatic nerve* is the *largest* nerve of the human body and, along with the *saphenous nerve*, supplies the skin of the lower leg. After passing through the *greater sciatic foramen* below the piriformis muscle, it moves along the back of the thigh to the *popliteal fossa*.) Above the popliteal fossa, it usually divides itself into the *tibial nerve* and the *common fibular (or peroneal) nerve*.

Even before the division of the sciatic nerve, a *fibular part* (F) can be distinguished from a *tibial part* (T). Each of them make branches for the following muscles:

- *Semitendinosus muscle* (T)
- *Semimembranosus muscle* (T)
- *Biceps femoris muscle*
  - Long head (T)
  - Short head (F)
- *Adductor magnus muscle* (T) (superficial part)

After its separation from the sciatic nerve at popliteal level, the *common fibular nerve* gives off two branches for the sensory innervation of the lateral and posterior lower leg: the *lateral sural cutaneous nerve* and the *communicating branches*, which, in order to ensure sensory supply of the posterior lower leg, merges with a branch of the tibial nerve to form the *sural nerve*.

The common fibular nerve moves around the *head of fibula* to the anterior side of the lower leg, and, after entering the *peroneal (fibularis) longus* muscle, it divides itself into its terminal branches: *superficial fibular (peroneal) nerve* and *deep fibular (peroneal) nerve* (for motor innervation: see table).
The **superficial fibular nerve** runs between the two **fibular muscles** to the dorsum where it ends in the sensory **medial and intermediate cutaneous nerves**, which innervate the dorsum and medial border of the foot.

The **deep fibular nerve** reaches the **extensor compartment** after breaking through the **anterior intermuscular septum** of leg and moves between the **tibialis anterior** and **extensor hallucis longus** muscles to the dorsal side of the foot. A sensory terminal branch supplies the skin of the first interdigital space (autonomous zone).

**Note:** In case of dysfunction of the fibular nerve, heel strike is no longer possible. Because of the resulting weakness of the extensor muscles, a characteristic **foot drop** can be observed.

The **tibial nerve** releases a **medial sural cutaneous nerve**, which merges with the **communicating fibular nerves** to form the **sural nerve** (course alongside the **small saphenous vein**), and moves caudal to the popliteal space between the heads of the **gastrocnemius** muscle, downwards in a vertical fashion.

Further in its course, it lays between the **soleus muscle** and the lower leg flexors which it also innervates. Along the **medial malleolus**, it reaches the **plantar aspect** of the foot where it divides into its terminal branches for motor and sensory innervation of the sole of the foot: **Medial plantar nerve** and **Lateral plantar nerve**.
Note: In case of dysfunction of the tibial nerve, the tip-toe stand is no longer possible.

<table>
<thead>
<tr>
<th>Nerve</th>
<th>Motor innervation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Superficial fibular (peroneal) nerve</td>
<td>M. fibularis longus; M. fibularis brevis</td>
</tr>
<tr>
<td>Deep fibular (peroneal) nerve</td>
<td>M. tibialis anterior; M. extensor digitorum longus; M. extensor hallucis longus; M. extensor digitorum brevis; M. extensor hallucis brevis</td>
</tr>
<tr>
<td>Tibial nerve</td>
<td>M. gastrocnemius; M. soleus; M. plantaris; M. tibialis posterior; M. flexor digitorum longus; M. flexor hallucis longus</td>
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</tbody>
</table>

For an overview of the sensory innervation of the lower limb, see the following figure:
Review Questions

Solutions can be found below the references.

1. **Which statement about the brachial plexus is correct?**

1. Failure of the radial nerve results in the characteristic simian hand.
2. The brachial plexus consists of the posterior branches of the spinal nerves of segments C5 – Th1.
3. The median nerve is the direct continuation of the posterior cord.
4. Patients with carpal tunnel syndrome present with nocturnal paresthesia.
5. Damage to the ulnar nerve can be detected by Tinel’s sign.

2. **Which nerve does not emerge directly or through a branch of another nerve from the lumbar plexus?**

1. Saphenous nerve
2. Genital branch
3. Anterior labial nerve
4. Lateral cutaneous femoral nerve
5. Sural nerve

3. Which structure does not pass through the foramen infrapiriforme?

1. Sciatic nerve
2. Superior gluteal nerve
3. Inferior gluteal artery
4. Posterior femoral cutaneous nerve
5. Inferior gluteal vein

References
Duale Reihe Anatomie, 2. Auflage – Thieme Verlag
Duale Reihe Neurologie, 6. Auflage – Thieme Verlag
Prometheus, Allgemeine Anatomie und Bewegungssystem, 2. Auflage – Thieme Verlag

Correct answers: 1D, 2E, 3B

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