Lumbosacral Plexus — Anatomy and Nerves

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.

Lumbosacral Plexus

The lumbosacral plexus is formed by the anterior rami of the nerves (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 the 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, one 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 the **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 the labia majora.
It also provides motor innervation to the caudal portions of the **transverse abdominis** and **internal oblique muscles** of the abdomen and as sensory branches possess the **femoral branch** supplying the upper and inner parts of the anterior thigh, and **anterior scrotal nerve** supplying the anterior part of the scrotum (or labia majora 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. It passes 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 the **femoral artery and vein**.

**Note:** **NAVEL** summarizes the position of the structures in the muscular lacuna: nerve, artery, vein, empty space, lymphatics!
Just below the inguinal ligament, nerves divide 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, 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 a palm-sized area at the distal end of the inner thigh.

Sacral Plexus
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

**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 3 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 1 leg, the pelvis tilts towards the healthy side resulting in a waddling gait called Trendelenburg gait or gluteal gait.
Inferior gluteal nerve

The 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, climbing stairs, and jumping.

Coccygeal nerve

- Nerves to levator ani and coccygeus (Sr, S4) >> Muscles of the 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 makes 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 2 branches for the sensory innervation of the lateral and posterior lower leg: the lateral sural cutaneous nerve and the communicating branches, which 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 a 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 2 **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. Sensory terminal branch supplies the skin of the first interdigital space (autonomous zone).

**Note:** In case of dysfunction of the fibular nerve, a 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: **medial plantar nerve** and **lateral plantar nerve**.
**Note:** In case of dysfunction of the tibial nerve, the tip-toe stand is not possible.

<table>
<thead>
<tr>
<th>Nerve</th>
<th>Motor innervation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Superficial fibular (peroneal) nerve</td>
<td>musculus fibularis longus; musculus fibularis brevis</td>
</tr>
<tr>
<td>Deep fibular (peroneal) nerve</td>
<td>musculus tibialis anterior; musculus extensor digitorum longus;</td>
</tr>
<tr>
<td></td>
<td>musculus extensor hallucis longus; musculus extensor digitorum brevis;</td>
</tr>
<tr>
<td></td>
<td>musculus extensor hallucis brevis</td>
</tr>
<tr>
<td>Tibial nerve</td>
<td>musculus gastrocnemius; musculus soleus; musculus plantaris;</td>
</tr>
<tr>
<td></td>
<td>musculus tibialis posterior; musculus flexor digitorum longus;</td>
</tr>
<tr>
<td></td>
<td>musculus flexor hallucis longus</td>
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</tbody>
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For an overview of the sensory innervation of the lower limb, see the following figure:
Image: Sensory supply of the lower limb. By Henry Gray, License: Public domain

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