Muscles of the Foot
Lecture Objectives

• Describe the movement of the toes.
• List the muscles acting on the toes.
• Describe the flexor and extensor retinacula and the structures passing in relation to them.
• Describe the retinacula which are related to the foot and the structures passing in relation to the retinacula.
• Describe the four muscle layers of the foot.
Extensor Retinacula

• Superior extensor retinaculum
  • Between the leg bones above the malleoli
• Inferior Extensor retinaculum
  • In front of the ankle joint
  • Originates from the lateral surface of the calcaneus and tarsal sinus
• Y-shaped
  • Superior band – passes to the medial malleolus
  • Inferior band – to the navicular and medial cuneiform bones
Extensor Retinacula

• Three compartments with three synovial sheathes
Lateral (peroneal) Retinacula

- Superior peroneal retinaculum
  - From the lateral malleolus to the calcaneus
  - Common synovial sheath

- Inferior peroneal retinaculum
  - Located on the lateral surface of the calcaneum
  - Separated synovial sheaths
Medial (Flexor) Retinaculum

- Passes from the calcaneus to the medial malleolus
- Passing structures & synovial sheathes

Anterior → Posterior
I – synovial sheath of the tibialis posterior
II - synovial sheath of the flexor digitorum longus
III – posterior tibial artery and tibial nerve
IV – synovial sheath of the flexor hallucis longus
FIGURE 10.48 Relations of the right ankle joint.
Muscles of the Dorsum of Foot

- Extensor digitorum brevis m.
- Extensor hallucis brevis m.
<table>
<thead>
<tr>
<th>Muscle</th>
<th>Proximal Attachment</th>
<th>Distal Attachment</th>
<th>Innervation(^a)</th>
<th>Main Action</th>
</tr>
</thead>
</table>
| Extensor digitorum brevis | Calcaneus (floor of tarsal sinus); interosseous talocalcaneal liga-
|                         | ment; stem of inferior extensor retinaculum               | Long extensor tendons of four medial digits (toes 2–4)       | Deep fibular nerve (L5 or S1, or both)                       | Aids the extensor digitorum longus in extending the four medial toes at the metatarsophalangeal and interphalangeal joints |
| Extensor hallucis brevis | In common with extensor digitorum brevis (above)          | Dorsal aspect of base of proximal phalanx of great toe (digit 1) |                                                             | Aids the extensor hallucis longus in extending the great toe at the metatarsophalangeal joint     |

\(^a\) The spinal cord segmental innervation is indicated (e.g., “L5 or S1” means that the nerve supplying the extensor digitorum brevis is derived from either the fifth lumbar segment or first sacral segment of the spinal cord). Damage to one or more of the listed spinal cord segments or to the motor nerve roots arising from them results in paralysis of the muscles concerned.
Dorsalis Pedis Artery

• Superficial

• Relations
  • Inferior extensor retinaculum
  • Deep to 1st tendon of extensor digitorum (hallucis) pervis m.
  • Penetrate 1st dorsal interosseous m.
  • At planter side join the planter arch
Muscles of the Sole of Foot

• 1\textsuperscript{st} layer
  • Abductor hallucis m.
  • Flexor digitorum brevis m.
    – middle phalanges
  • Abductor digiti minimi m.
Muscles of the Sole of Foot

• 2\textsuperscript{nd} layer
  • Quadratus plantae m. – fixes the flexor digitorum longus tendons
  • Lumbricals
  • Tendons of flexor digitorum longus
  • Tendon of flexor hallucis longus
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</thead>
<tbody>
<tr>
<td><strong>1st layer</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abductor hallucis</td>
<td>Medial tubercle of tuberosity of calcaneus; flexor retinaculum; plantar aponeurosis</td>
<td>Medial side of base of proximal phalanx of 1st digit</td>
<td>Medial plantar nerve (S2, S3)</td>
<td>Abducts and flexes 1st digit (great toe, hallux)</td>
</tr>
<tr>
<td>Flexor digitorum brevis</td>
<td>Medial tubercle of tuberosity of calcaneus; plantar aponeurosis; intermuscular septa</td>
<td>Both sides of middle phalanges of lateral four digits</td>
<td>Medial plantar nerve (S2, S3)</td>
<td>Flexes lateral four digits</td>
</tr>
<tr>
<td>Abductor digiti minimi</td>
<td>Medial and lateral tubercles of tuberosity of calcaneus; plantar aponeurosis; intermuscular septa</td>
<td>Lateral side of base of proximal phalanx of 5th digit</td>
<td>Lateral plantar nerve (S2, S3)</td>
<td>Abducts and flexes little toe (5th digit)</td>
</tr>
<tr>
<td><strong>2nd layer</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quadratus plantae</td>
<td>Medial surface and lateral margin of plantar surface of calcaneus</td>
<td>Posterolateral margin of tendon of flexor digitorum longus</td>
<td>Lateral plantar nerve (S2, S3)</td>
<td>Assists flexor digitorum longus in flexing lateral four digits</td>
</tr>
<tr>
<td>Lumbricals</td>
<td>Tendons of flexor digitorum longus</td>
<td>Medial aspect of expansion over lateral four digits</td>
<td>Medial one: medial plantar nerve (S2, S3)</td>
<td>Flex proximal phalanges, extend middle and distal phalanges of lateral four digits</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lateral three: lateral plantar nerve (S2, S3)</td>
<td></td>
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<sup>a</sup> The spinal cord segmental innervation is indicated (e.g., “S2, S3” means that the nerves supplying the abductor hallucis are derived from the second and third sacral segments of the spinal cord). Damage to one or more of the listed spinal cord segments or to the motor nerve roots arising from them results in paralysis of the muscles concerned.

<sup>b</sup> Despite individual actions, the primary function of the intrinsic muscles of the sole of the foot is to resist flattening or maintain the arch of the foot.
Muscles of the Sole of Foot

• 3rd layer
  • Flexor hallucis brevis m. – two sesamoid bones
  • Adductor hallucis m. – transverse & oblique heads
  • Flexor digiti minimi brevis m.
Muscles of the Sole of Foot

• 4\textsuperscript{th} layer
  • Planter interossei mm. – 1\textsuperscript{st}-3\textsuperscript{rd} (adductors)
  • Dorsal interossei mm. – 1\textsuperscript{st}- 4\textsuperscript{th} (abductors)
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<tr>
<td><strong>3rd layer</strong></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Flexor hallucis brevis</td>
<td>Plantar surfaces of cuboid and lateral cuneiforms</td>
<td>Both sides of base of proximal phalanx of 1st digit</td>
<td>Medial plantar nerve (S2, S3)</td>
<td>Flexes proximal phalanx of 1st digit</td>
</tr>
<tr>
<td>Adductor hallucis</td>
<td>Oblique head: bases of metatarsals 2–4</td>
<td>Tendons of both heads attach to lateral side of base of proximal phalanx of 1st digit</td>
<td>Deep branch of lateral plantar nerve (S2, S3)</td>
<td>Traditionally said to adduct 1st digit; assists in transverse arch of foot by metatarsals medially</td>
</tr>
<tr>
<td>Flexor digit minimi brevis</td>
<td>Base of 5th metatarsal</td>
<td>Base of proximal phalanx of 5th digit</td>
<td>Superficial branch of lateral plantar nerve (S2, S3)</td>
<td>Flexes proximal phalanx of 5th digit, thereby assisting with its flexion</td>
</tr>
<tr>
<td><strong>4th layer</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plantar interossei (three muscles)</td>
<td>Bases and medial sides of metatarsals 3–5</td>
<td>Medial sides of bases of phalanges of 3rd–5th digits</td>
<td>Lateral plantar nerve (S2, S3)</td>
<td>Adduct digits (2–4) and flex metatarsophalangeal joints</td>
</tr>
<tr>
<td>Dorsal interossei (four muscles)</td>
<td>Adjacent sides of metatarsals 1–5</td>
<td>1st: medial side of proximal phalanx of 2nd digit; 2nd–4th: lateral sides of 2nd–4th digits</td>
<td>Lateral plantar nerve (S2, S3)</td>
<td>Abduct digits (2–4) and flex metatarsophalangeal joints</td>
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Posterior Tibial Artery

- Medial planter a.
  - Smaller
  - Deep to abductor hallucis m.
- Lateral planter a.
  - Deep to the abductor hallucis m. and flexor digitorum brevis m.
  - Continue as planter arch
    - Planter digital aa.
Tibial Nerve: Branches in sole

- Medial planter n.
  - Companies medial planter a.
  - Deep to abductor hallucis m.

- Lateral planter n.
  - Companies lateral planter a.
  - Deep to abductor hallucis & flexor digitorum brevis mm.
Surface Anatomy of Foot