6.3C: Microscopic Anatomy of Bone

The basic microscopic unit of bone is an osteon, which can be arranged into woven bone or lamellar bone.

Learning Objectives

- Classify woven bone and lamellar bone

Key Points

- Woven bone is found on the growing ends of an immature skeleton or, in adults, at the site of a healing fracture.
- Woven bone is characterized by the irregular organization of collagen fibers and is mechanically weak, but forms quickly.
- Lamellar bone is much stronger than woven bone, and is highly organized in concentric sheets with a much lower proportion of osteocytes to mineralized tissue.
- When the same lamellar bone is loosely arranged, it is referred to as trabecular bone. Trabecular bone gets its name because of the spongy pattern it displays on an x-ray.
- After a fracture, woven bone forms initially and is gradually replaced by lamellar bone during a process known as bony substitution.

Key Terms

- **osteoblast**: A mononucleate cell from which bone develops.
- **osteocytes**: A star-shaped type of bone cell that is found in the cells of mature bone.
- **lamellar bone**: A bone with a regular, parallel alignment of collagen into sheets (lamellae) that is mechanically...
strong.

- **woven bone**: Characterized by an irregular organization of collagen fibers, this bone is mechanically weak.

Bones are composed of bone matrix, which has both organic and inorganic components. Bone matrix is laid down by osteoblasts as collagen, also known as osteoid. Osteoid is hardened with inorganic salts, such as calcium and phosphate, and by the chemicals released from the osteoblasts through a process known as mineralization.

The basic microscopic unit of bone is an osteon (or Haversian system). Osteons are roughly cylindrical structures that can measure several millimeters long and around 0.2 mm in diameter.

Each osteon consists of a lamellae of compact bone tissue that surround a central canal (Haversian canal). The Haversian canal contains the bone’s blood supplies. The boundary of an osteon is called the cement line. Osteons can be arranged into woven bone or lamellar bone.

**Osteon**: A photo taken through a microscope that shows the anatomy of compact bone with a detailed view of an osteon.

**Woven Bone**
**Woven Bone**: Woven bone is characterized by the irregular organization of collagen fibers and is mechanically weak. Woven bone is found on the growing ends of an immature skeleton or, in adults, at the site of a healing fracture. Woven bone is characterized by the irregular organization of collagen fibers and is mechanically weak, but forms quickly.

The criss-cross appearance of the fibrous matrix is why it is referred to as woven. It has a high proportion of osteocytes to hard inorganic salts that leads to its mechanical weakness.

Woven bone is replaced by lamellar bone during development. In contrast to woven bone, lamellar bone is highly organized in concentric sheets with a much lower proportion of osteocytes to surrounding tissue. The regular parallel alignment of collagen into sheets, or, lamellae, causes lamellar bone to be mechanically strong.

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**Lamellar Bone**

**Femur head showing trabecular bone**: A cross-section of the head of the femur showing lamellar bone on the borders and trabecular bone in the center.

Lamellar bone makes up the compact or cortical bone in the skeleton, such as the long bones of the legs and arms. In a cross-section, the fibers of lamellar bone can be seen to run in opposite directions in alternating layers, much like in plywood, assisting in the bone’s ability to resist torsion forces.

When the same lamellar bone is loosely arranged, it is referred to as trabecular bone. Trabecular bone gets its name because of the spongy pattern it displays in an x-ray. The spaces within trabecular bone are filled with active bone marrow.

After a fracture, woven bone forms initially, but it is gradually replaced by lamellar bone during a process known as bony substitution.