38.2B: Cell Types in Bones

The osteoblast, osteoclast, osteocyte, and osteoprogenitor bone cells are responsible for the growing, shaping, and maintenance of bones.

Learning Objectives

- Distinguish among the four cell types in bone

Bone consists of four types of cells: osteoblasts, osteoclasts, osteocytes, and osteoprogenitor (or osteogenic) cells. Each cell type has a unique function and is found in different locations in bones. The osteoblast, the bone cell responsible for forming new bone, is found in the growing portions of bone, including the periosteum and endosteum. Osteoblasts, which do not divide, synthesize and secrete the collagen matrix and calcium salts. As the secreted matrix surrounding the osteoblast calcifies, the osteoblast becomes trapped within it. As a result, it changes in structure, becoming an osteocyte, the primary cell of mature bone and the most common type of bone cell. Each osteocyte is located in a space (lacuna) surrounded by bone tissue. Osteocytes maintain the mineral concentration of the matrix via the secretion of enzymes. As is the case with osteoblasts, osteocytes lack mitotic activity. They are able to communicate with each other and receive nutrients via long cytoplasmic processes that extend through canaliculi (singular = canaliculus), channels within the bone matrix.

<table>
<thead>
<tr>
<th>Bone Cells</th>
<th>Function</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Osteoblasts</td>
<td>Bone formation</td>
<td>Growing portions of bone, including periosteum and endosteum</td>
</tr>
<tr>
<td>Osteocytes</td>
<td>Maintain mineral concentration of matrix</td>
<td>Engraved in matrix</td>
</tr>
<tr>
<td>Osteoclasts</td>
<td>Osteoclast reseption</td>
<td>Bone surfaces and at sites of old, injured, or unneeded bone</td>
</tr>
</tbody>
</table>

Figure \(\PageIndex{1}\): Bone cell types: Table listing the function and location of the four types of bone cells.
Figure 4.1: Four types of bone cells: Four types of cells are found within bone tissue. Osteogenic cells are undifferentiated and develop into osteoblasts. When osteoblasts get trapped within the calcified matrix, their structure and function changes; they become osteocytes. Osteoclasts develop from monocytes and macrophages and differ in appearance from other bone cells.

If osteoblasts and osteocytes are incapable of mitosis, then how are they replenished when old ones die? The answer lies in the properties of a third category of bone cells: the osteogenic cell. These osteogenic cells are undifferentiated with high mitotic activity; they are the only bone cells that divide. Immature osteogenic cells are found in the deep layers of the periosteum and the marrow. When they differentiate, they develop into osteoblasts. The dynamic nature of bone means that new tissue is constantly formed, while old, injured, or unnecessary bone is dissolved for repair or for calcium release. The cell responsible for bone resorption, or breakdown, is the osteoclast, which is found on bone surfaces, is multinucleated, and originates from monocytes and macrophages (two types of white blood cells) rather than from osteogenic cells. Osteoclasts continually break down old bone while osteoblasts continually form new bone. The ongoing balance between osteoblasts and osteoclasts is responsible for the constant, but subtle, reshaping of bone.

Key Points

- Osteogenic cells are the only bone cells that divide.
- Osteogenic cells differentiate and develop into osteoblasts which, in turn, are responsible for forming new bones.
- Osteoblasts synthesize and secrete a collagen matrix and calcium salts.
- When the area surrounding an osteoblast calcifies, the osteoblast becomes trapped and transforms into an osteocyte, the most common and mature type of bone cell.
- Osteoclasts, the cells that break down and reabsorb bone, stem from monocytes and macrophages rather than osteogenic cells.
- There is a continual balance between osteoblasts generating new bone and osteoclasts breaking down bone.

Key Terms

- osteoclast: a large multinuclear cell associated with the resorption of bone
- osteocyte: a mature bone cell involved with the maintenance of bone
- **osteoprogenitor**: a stem cell that is the precursor of an osteoblast
- **canaliculus**: any of many small canals or ducts in bone or in some plants
- **periosteum**: a membrane surrounding a bone
- **endosteum**: a membranous vascular layer of cells which line the medullary cavity of a bone
- **lacuna**: a small opening; a small pit or depression; a small blank space; a gap or vacancy; a hiatus
- **osteoblast**: a mononucleate cell from which bone develops