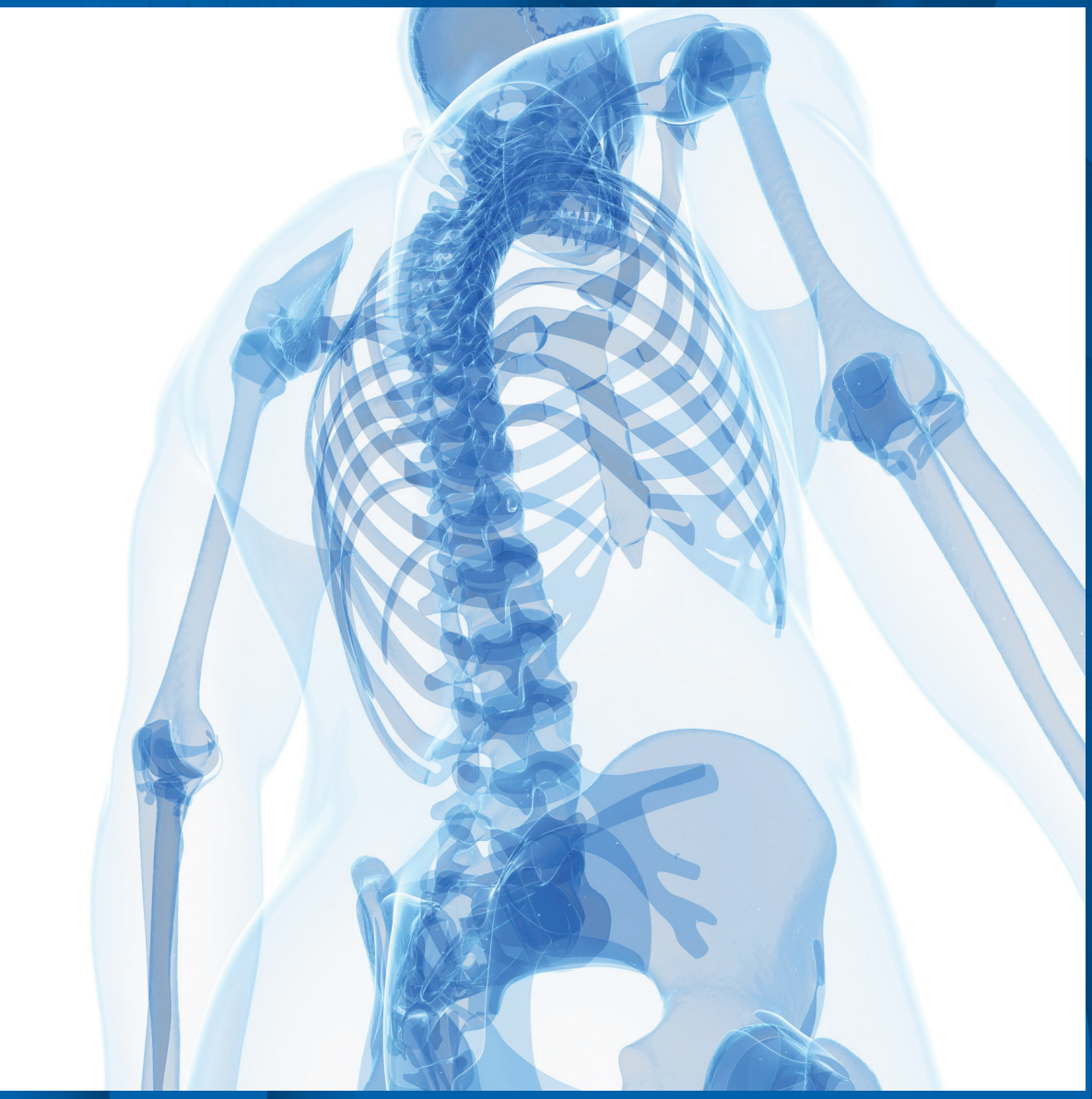
National Association of Orthopaedic Nurses

Advancing the Art and Science of Orthopaedic Care

An Introduction to Orthopaedic Nursing



5th Edition

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An Introduction to Orthopaedic Nursing, 5th Edition, is intended to support and enhance knowledge of nurses new to and/or interested in care of orthopaedic patients. Information in this publication has been authored and peer-reviewed by experts in the field and reflects current evidence and research. The rapid pace of innovation and constant change in health care is evident across the care continuum and are closely scrutinized. Changes in best practices are inevitable as current strategies are replaced by those with better results. Individual providers, teams, and facilities are accountable for using their own knowledge and expertise when determining the course of action in a patient care situation. The National Association of Orthopaedic Nurses (NAON) as the publisher, the authors, the contributors, and the editors assume no liability for any injury or damage to persons or property from the use of instructions, products, methods, or other ideas in this book.

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Advancing the Art and Science of Orthopaedic Care

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FIFTH EDITION

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Preface

Caring for patients in their most vulnerable moments is a sacred trust. Providing the highest quality nursing care based on current evidence is a compelling responsibility. Today's complicated healthcare landscape mandates a rapid pace of change to accommodate the most up-to-date regulations, evidence, and best practices. Caring for patients with varied musculoskeletal conditions requires a specialized body of knowledge and expertise. Skilled and knowledgeable nurses are empowered to provide excellent care, intervene to prevent injuries and complications, and maintain safety for the staff and for the patient. It is with these thoughts in mind that we offer the fifth edition of NAON's *An Introduction to Orthopaedic Nursing*.

The target audience for this manual is the bedside nurse providing direct patient care in a clinical setting. It is a solid reference for others in the continuum of care - clinical nurse specialists, bedside care providers, nurse practitioners, educators, and students. This manual continues to be a learning tool for nurses new to the orthopaedic environment, as well as those who wish to brush up on less frequently seen conditions. It is a solid reference for a team to develop competencies, policies and protocols.

Arranged in a chapter format to afford quick referencing, this edition is spiral bound to accommodate extensive use. The manual begins with an overview of musculoskeletal anatomy and the foundational neurovascular assessment. The following chapters then discuss conditions related to different locations – upper extremity, spine, knee, and hip/foot/ankle. Conditions related to traumatic injury are detailed, followed by an updated chapter on the management of pain in the orthopaedic patient. Complications common (and less common) to the orthopaedic patient population are discussed, with the final chapter addressing patient mobilization, safe patient handling and applicable post-surgical precautions. Each chapter begins by presenting the learner objectives and key terms and definitions specific to the content.

The interventions of orthopaedic nurses correlate directly to optimal patient outcomes. This truth is detailed as concepts unique to orthopaedic patient care are explored – rapid mobilization, preventing and detecting complications, patient and family education, appropriate equipment and techniques, conservative and surgical management of various conditions. The reviews of internal and external fixation, as well as traction, reflect a comprehensive presentation of the many options for treatment of fractures.

Great thought and research was put into the production of this manual. I commend the editor, authors and reviewers, experts in their field, for their hard work and dedication to produce this excellent reference and resource. The orthopaedic nurse is required to be both caring and technically expert. The nurse must be armed with advanced critical thinking and make decisions that result in excellent patient outcomes. We pray this reference supports you in those endeavors.

Take care,

Tandy Gabbert, MSN, RN, ONC

Director of Education,
National Association of Orthopaedic Nurses

Contact Hours

NAON will offer contact hour opportunities for this new edition. Post-test questions for each chapter will be available in the NAON Online Store in 2018. For questions, please contact the NAON National Office at naon@orthonurse.org or 1 (800) 289-6266.

Musculoskeletal Anatomy and Neurovascular Assessment

Nicole Sarauer, APRN, CNS, ONC®

Objectives

- Describe the micro- and macroscopic structure, function, and types of bone.
- Identify the neurovascular and musculoskeletal components of a comprehensive assessment.
- Identify assessment parameters for a nursing history and assessment.
- Describe potential patient outcomes that may occur secondary to abnormal neurovascular findings.

Key Terms

Blanch: to lose color; to assess the integrity of the circulation by applying and then quickly releasing pressure on a fingernail or toenail

Cancellous bone: a type of structural organization of woven bone characterized by a spongy or latticelike structure

Capillary refill: the amount of time it takes a blanched nail bed to return to a normal pink appearance; generally 2 to 3 seconds

Compact bone: dense or cortical bone

Cortex: the dense bone that forms the external surface of a bone

Diaphysis: the central part of the shaft of a long tubular bone

Endosteum: the membrane lining the medullary cavity of a bone

Epiphyseal plate: the zone of cartilage between the epiphysis and the metaphysis, responsible for the longitudinal growth of bones; also known as the physis or growth plate

Epiphyses: the ends of a bone that lie between the joint surface on one side and the epiphyseal plate on the other

Flat bone: a bone that is in the form of a plate, with broad, curved surfaces for muscle attachments (e.g., scapula, ribs, pelvis, and parietal bones)

Haversian system: the functional unit of mature cortical bone; also known as an osteon

Innervation: nerve supply to a specific body part

Irregular bone: a bone with varied shapes and many surface features for muscle attachment or articulations (e.g., vertebrae)

Ischemia: temporary deficiency of blood flow to an organ or tissue

Long bone: an elongated bone of the extremities that consists of a diaphyseal shaft and wider epiphyseal articulating ends (e.g., tibia)

Medullary cavity: a marrow-filled space within the diaphysis of a long bone; also known as the marrow cavity or intramedullary cavity

Metaphysis: the widened end of the long bone shaft between the diaphysis and epiphysis

Osteoblast: the basic cell that forms all bones

Osteoclast: a large, multinucleated bone cell that reabsorbs mineralized bone matrix, thus breaking down bone

Osteocyte: a mature bone cell derived from the osteoblast

Osteogenic cells: cells that differentiate into osteoblasts and osteoclasts; found in the medullary cavity between the periosteum and bone

Osteoid: the organic matrix formed by the osteoblast; becomes bone when mineralized

Key Terms *(continued)*

Paresthesia: an abnormal or unpleasant sensation that results from injury to one or more nerves; often described by patients as numbness or a prickly, stinging, or burning feeling

Periosteum: a specialized connective tissue membrane that covers bone surfaces except for the points of tendon and ligament attachments and the articular surfaces

Pulse points: palpable pulses of the body caused by the regular contraction and expansion of an artery as a wave of blood passes through

Sesamoid bone: an ovoid nodule of bone that develops within a tendon (e.g., patella)

Short bone: a cube-shaped bone nearly equal in length and width to a thin layer of compact bone covering cancellous bone (e.g., carpals)

Trabeculae: the name given to the latticework structures of cancellous bone

The musculoskeletal system plays many different roles. People often take the musculoskeletal system for granted until an injury occurs and impacts one or more of these roles. Many structures make up this unique system. All play an integral role in assisting the body with movement, support, protection, and maintaining a state of balance. The goal of this chapter is to discuss the structures and evaluation of the musculoskeletal and neurovascular systems and demonstrate their individual and combined functions.

Bones

The bones that make up the body are an integral part of the musculoskeletal system. There are 206 bones in an adult human skeleton. Humans are born with nearly 300 bones, but many fuse together over time. There are two main parts of the human skeleton: the axial and appendicular skeleton.

The axial skeleton is made up of 80 bones including the skull, vertebrae, rib cage, and the ossicles in the ears. The axial skeleton serves to protect vital organs of the body such as the brain, spinal cord, heart, and lungs (see Figure 1-1*a*). This division of the skeleton contributes to our ability to stand upright, which is directly linked to the vertebral column (Lewis et al., 2017). The appendicular skeleton contains 126 bones, which include the pelvic girdle, shoulder girdle, and extremities. There are 54 bones in the hands and wrists alone (see Figure 1-1*b*).

The skeletal system serves many important functions. The bones provide support and stability for the body and aid in movement. Bones provide the structure for attachment of muscles, which are connected through fibrous tissue called tendons. The skeleton also serves as a frontline defense to protect the fragile tissue of the body's vital organs. One important function of bone that is not so obvious is storage. Bone tissue stores and releases essential minerals, such as phosphate and calcium. Through a delicate balance of storage and release of these minerals, the bones help the body maintain homeostasis. Lastly, bones produce blood cells, a process called hematopoiesis (Lewis et al., 2017).

There are two different types of bone: cortical bone and cancellous bone (see Figure 1-2). Cortical bone, also known

Figure 1-1a
Axial Skeleton

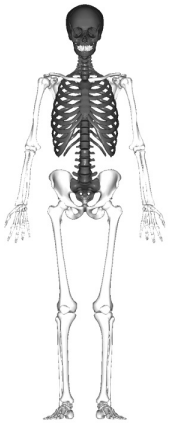

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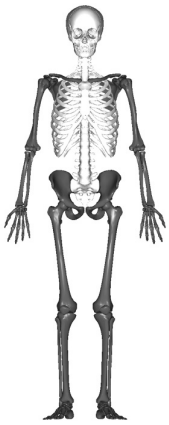
Figure 1-1b
Appendicular Skeleton



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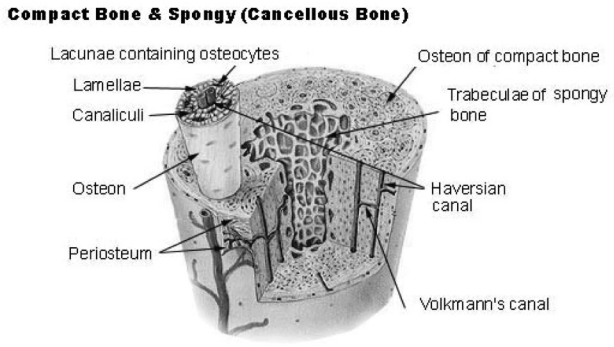
as compact bone, is a very dense type of bone. Approximately 80% of the skeleton is composed of cortical bone. Its primary functions are to provide structural strength to the skeleton and help the body maintain homeostasis through the release and resorption of calcium (Petre, 2013; Rizzo, 2012). A large portion of the strength for cortical bone comes from the harversian system (Ignatavicius & Workman, 2016). Haversian systems, or osteons, are made of concentric circles of compact bone tissue with a central harversian canal through which blood vessels run in a longitudinal tunnel through the length of the bone (Petre, 2013; Rizzo, 2012). The harversian systems run longitudinally within the compact bone and are separated from other osteons by a cement line and interstitial lamellae, which are remnants of osteons that have been partially reabsorbed (Petre, 2013; Rizzo, 2012). A view of an osteon through a microscope would yield a picture much like the concentric circles in the cross section of a tree. Compact bone is made of several osteons that are situated parallel to each other.

Figure 1-2
Compact and Cancellous bone



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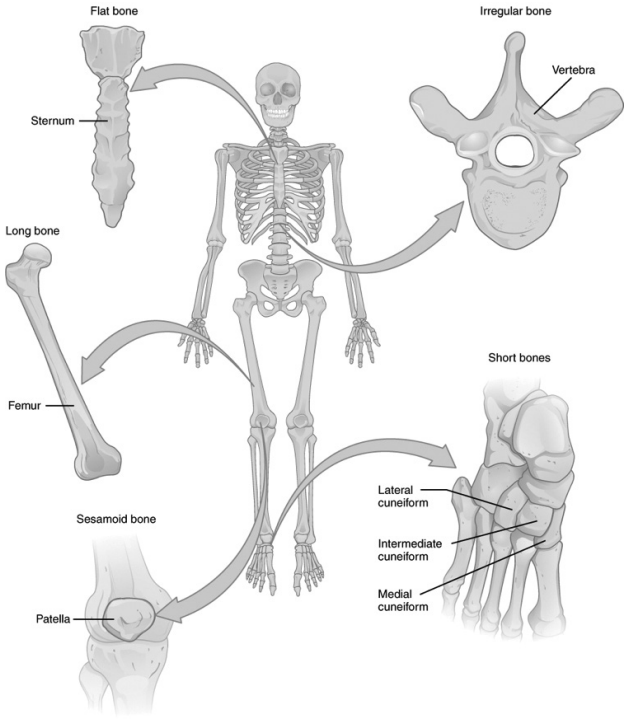
The other type of bone tissue, called cancellous bone, is much less dense than cortical bone. Cancellous bone, also called trabecular bone or spongy bone, does not contain harversian systems and has a latticelike structure (Lewis et al., 2017). The inside contains trabeculae (Latin for "small beam"), which are interconnected in a sponge or honeycomb-like appearance. Trabeculae are formed at sites of stress on the bone, contributing to the overall strength of the bone (Petre, 2013; Rizzo, 2012). Cancellous bone houses both red and yellow marrow. Red marrow is the site of blood cell production (hematopoiesis), whereas yellow marrow is primarily composed of fat cells.

Bones are also classified according to shape (see Figure 1-3). Long bones are cylindrical with ends that flare and become rounded, with a length greater than their width. The main function of long bones is to act as a lever, working with the muscles to allow for movement and weight bearing. Most bones contain a combination of approximately 80% cortical and 20% cancellous bone (Petre, 2013; Rizzo, 2012). The femur, which is the largest bone in the body, is a good example of a long bone.

Short bones differ from long bones in that they are primarily made up of cancellous bone with a very thin layer of compact bone. Examples of short bones are the metacarpals of the hand and the metatarsals of the feet. Flat bones consist of a layer of cancellous bone sandwiched between two layers of compact bone. Flat bones are typically found in areas with vital organs that require protection. These bones often house hematopoiesis process centers. Examples of flat bones are the bones that compose the skull, the scapula, and the sternum. Irregular bones vary in shape and size (Rizzo, 2012). Examples of irregular bones include the ossicles in the ear, the sacrum, and the mandible. A fifth type of bone is the sesamoid bone, which is usually embedded in a tendon or muscle and is frequently located over an angular structure of the body. The patella, which sits within the intersection of the quadriceps and the patella tendon, is the largest sesamoid in the body (Osborn, Wraa, Watson, & Holleran, 2014).

Figure 1-3
Bone Classification



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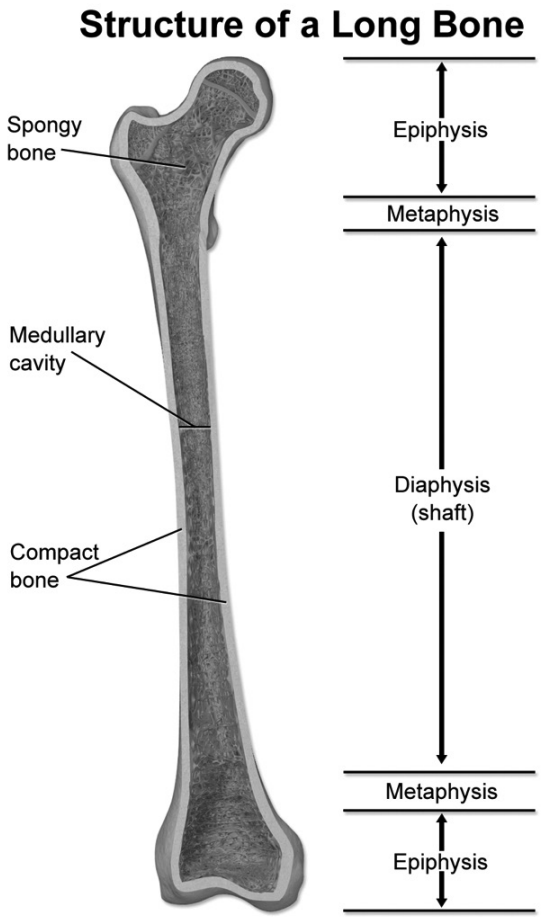
Structure of Long Bones

There are three primary parts of a long bone (see Figure 1-4). The wide, flared area at the end of each bone is called the epiphysis. It is composed mostly of cancellous bone with a thin layer of cortical bone. The wide structure of the epiphysis allows for greater stability and weight distribution. This is important given the epiphysis is the area of the bone involved in a joint and may have a weight-bearing function (Ignatavicius & Workman, 2016). The epiphysis frequently serves as an area of muscle attachment. The epiphyseal plate, located within the epiphysis, is a thin layer of cartilaginous tissue that allows for longitudinal bone growth in children, eventually calcifying and turning into solid bone as a child transitions to adulthood (Schoenly, 2013). Injury to the epiphyseal plate in childhood can impact bone growth and result in a structurally shorter bone (Ignatavicius & Workman, 2016).

Figure 1-4
Structure of a Long Bone



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The diaphysis is the longest part of the bone, or the shaft. It is composed mainly of compact bone and provides structural support. The metaphysis is the area where the diaphysis widens to become the epiphysis (Ignatavicius & Workman, 2016).

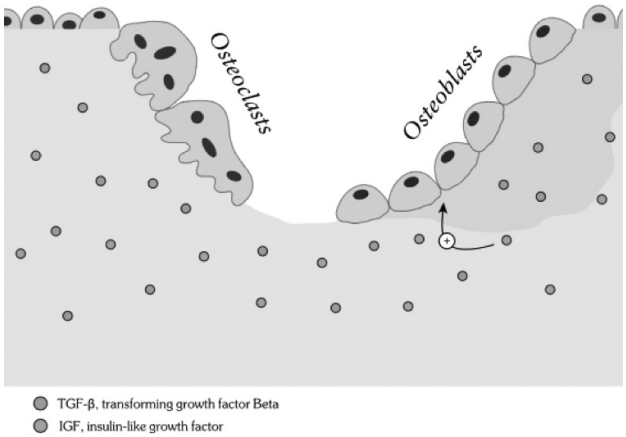
Bone Tissue and Bone Cells

The periosteum is the outer covering of bone and is composed of an outer layer of fibrous connective tissue. There is an inner layer that houses cells responsible for bone growth called bone progenitors. In addition, the vascular supply and nutrients for the outer portion of the bone are an important component of the periosteum (Petre, 2013; Rizzo, 2012).

The endosteum is a one-cell-wide layer that is present on the trabeculae of cancellous bone and the inner surface of compact bone. The endosteum houses a type of bone cell that prevents excess breakdown by other bone cells (Petre, 2013; Rizzo, 2012).

Osteoblasts are cells that form bone tissue (see Figure 1-5). Some people remember the building function associated with osteoblasts since both words contain the letter b. One might say osteoblasts are the foreman on the crew of bone cells. They are responsible for the building of bone and participate in the regulating activity of other bone cells, in particular the osteoclasts. Eventually, osteoblasts become osteocytes, or mature bone cells, which are merged into compact bone. About 90% of all bone cells are osteocytes and their life span is decades long (Petre, 2013; Rizzo, 2012). Although they no longer build bone, osteocytes are important to bone maintenance and homeostasis.

Figure 1-5
Osteoblasts and Osteoclasts



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The purpose of this Index is to point the learner to the most informative explanations of the terms. The Index does not show every listing for a term, in order to prevent repetitive information and to minimize search time.

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