Click to verify

Skip to main content Approximately 1.71 billion people have musculoskeletal conditions worldwide. Musculoskeletal conditions are the leading contributor to disability worldwide, with low back pain being the single leading cause of disability in 160 countries. Musculoskeletal conditions significantly limit mobility and dexterity, leading to early retirement from work, lower levels of well-being and reduced ability to participate in society. Because of population growth and ageing, the number of people living with musculoskeletal conditions and associated functional limitations, is rapidly increasing. WHO is responding to the burden attributed to musculoskeletal conditions across a number of programmatic areas. Musculoskeletal health refers to the performance of the locomotor system, comprising intact muscles, bones, joints and adjacent connective tissues. Musculoskeletal impairments comprise more than 150 different diseases/conditions that affect the system and are characterized by impairments in the muscles, bones, joints and adjacent connective tissues leading to temporary or lifelong limitations in functioning and participation. Musculoskeletal conditions are typically characterized by pain (often persistent) and limitations in mobility and dexterity, reducing peoples ability to work and participate in society. Pain experienced in musculoskeletal structures is the most common form of non-cancer pain.Musculoskeletal conditions are relevant across the life-course from childhood to older age. They range from those conditions that arise suddenly and are short-lived (such as fractures, sprains and strains, associated with pain and limitations in functioning) though to long-term conditions such as chronic primary low back pain and osteoarthritis.Musculoskeletal conditions include conditions that affect:joints, such as osteoarthritis, rheumatoid arthritis, psoriatic arthritis, gout, spondyloarthritis;bones, such as osteoporosis, osteopenia and associated fragility fractures, traumatic fractures;muscles, such as sarcopenia;multiple body areas or systems, such as regional (e.g. back and neck pain) and widespread (e.g. fibromyalgia) pain conditions, inflammatory diseases such as connective tissue diseases and vasculitis that have musculoskeletal manifestations, for example systemic lupus erythematosus, or amputation as a result of disease or trauma.Musculoskeletal conditions are also the highest contributor to the global need for rehabilitation. They are among the largest contributors to the need for rehabilitation services among children and account for approximately two-thirds of all adults in need of rehabilitation (1). Musculoskeletal conditions often co-exist with other noncommunicable diseases and increase the risk of developing other noncommunicable diseases, such as cardiovascular disease (2). People with musculoskeletal conditions are also at higher risk to develop mental health issues.MagnitudeA recent analysis of Global Burden of Disease (GBD) 2019 data showed that approximately 1.71 billion people globally live with musculoskeletal conditions, including low back pain, neck pain, fractures, other injuries, osteoarthritis, amputation and rheumatoid arthritis (1). While the prevalence of musculoskeletal conditions varies by age and diagnosis, people of all ages everywhere around the world are affected. High-income countries are the most affected in terms of number of people 441 million followed by countries in the WHO Western Pacific Region with 427 million and South-East Asia Region with 369 million. Musculoskeletal conditions are also the biggest contributor to years lived with disability (YLDs) worldwide with approximately 149 million YLDs, accounting for 17% of all YLDs worldwide.Low back pain is the main contributor to the overall burden of musculoskeletal conditions (570 million prevalent cases worldwide, responsible for 7.4% of global YLDs). Other contributors to the overall burden of musculoskeletal conditions include fractures with 440 million people globally (26 million YLDs), osteoarthritis (528 million people; 19 million YLDs), neck pain (222 million people; 22 million YLDs), amputations (180 million people; 5.5 million YLDs), rheumatoid arthritis (18 million people; 2.4 million YLDs), gout (54 million people; 1.7 million YLDs) other musculoskeletal conditions (453 million people; 38 million YLDs) [data from IHME Viz Hub and WHO Rehabilitation Needs Estimator].While the prevalence of musculoskeletal conditions increases with age, younger people are also affected, often during their peak income-earning years. For example, childhood auto-immune inflammatory conditions such as juvenile arthritis affect childrens development, while low back pain is the main reason for a premature exit from the workforce. The societal impact of early retirement in terms of direct health-care costs and indirect costs (i.e., work absenteeism or productivity loss) is enormous. Projections show that the number of people with low back pain will increase in the future, and even more rapidly in low-income and middle-income countries (3).Health estimatesTheWHO Rehabilitation Need Estimatortool provides a unique opportunity to search for country, regional or global prevalence and YLD data on musculoskeletal conditions that can benefit from rehabilitation, based on GBD 2019 data. Similarly, the GBD Compare Tool also provides health estimates for musculoskeletal and other conditions. Variation in aggregated health estimates between the tools may be explained by differences in which specific musculoskeletal conditions and subgroups of those are included.The WHO Ageing Data Portal brings together data on available global indicators relevant to monitoring the health and well-being of people aged 60 years and over. Through maps, charts and tables, the portal offers tailored options for visualization and analysis of the data. The portal provides prevalence data for low back pain in older people.WHO responseRehabilitation 2030WHO launched the Rehabilitation 2030 initiative in 2017 to draw attention to the profound unmet need for rehabilitation worldwide, and to highlight the importance of strengthening rehabilitation in health systems. The initiative marks a new strategic approach for the global rehabilitation community by emphasizing that:Rehabilitation is an essential health service and crucial for achieving universal health coverage.Rehabilitation should be available for all the population, through all stages of the life course and along the continuum of care. This includes all people with musculoskeletal conditions.Efforts to strengthen rehabilitation should be directed towards supporting health systems as a whole and integrating rehabilitation into all levels of health care.The Rehabilitation 2030 initiative was launched to support countries to respond to existing rehabilitation needs, including of people with musculoskeletal conditions, as well as the forecasted increase arising from health and demographic trends. Rehabilitation is often not a political priority in countries and thus continues to be under-resourced. As a result, the rehabilitation needs of individuals continues to go unmet, leading to an exacerbation of their condition, lifelong consequences and inequities in health outcomes. Further information about the Rehabilitation 2030 initiative can be foundhere. WHO is also developing a Package of Interventions for Rehabilitation including the following musculoskeletal conditions: low back pain, osteoarthritis, rheumatoid arthritis, sarcopenia, fractures in the extremities, and amputation. Each package will contain a list of essential interventions for rehabilitation and the resources required to deliver them safely and effectively. These interventions will be relevant for people at all stages of life, along the continuum of care, across all service delivery platforms, and across all world regions, with a specific focus on low- and middle-resource contexts.The main target users of the Package of Interventions for Rehabilitation are Ministries of Health that can use this resource to plan and budget the integration of rehabilitation in their national health services. Other target users that may benefit from the Package of Interventions for Rehabilitation include researchers to identify rehabilitation research gaps; academics to develop curricula for the training of rehabilitation professionals; and service providers to plan and implement specific interventions in their rehabilitation programmes.More about the Package of Interventions for Rehabilitation of musculoskeletal conditions can be foundhere.Integrated Care for Older People (ICOPE)Integrated care for older people (ICOPE) reflects a continuum of care that helps to reorient health and social services towards a more person-centred and coordinated model of care to optimize older peoples intrinsic capacity (physical and mental capacities) and functional ability. Locomotor (musculoskeletal) capacity is a key component of intrinsic capacity. Delivery of integrated care and primary health services responsive to older people is one of the action areas of UN Decade of Healthy Ageing (20212030). WHO has developed tools to support countries for implementation of the ICOPE approach that include:WHO is currently developing evidence-based clinical guidelines for non-surgical management of chronic primary low back pain for adults. The recommendations to manage chronic primary low back pain will be integrated into ICOPE handbook.1. Cieza, A., Causey, K., Kamenov, K., Hanson, S. W., Chatterji, S., & Vos, T. (2021). Global estimates of the need for rehabilitation based on the Global Burden of Disease study 2019: a systematic analysis for the Global Burden of Disease Study 2019. The Lancet, 396(10267), 20062017.2. Williams A, Kamper SJ, Wiggers JH, O'Brien KM, Lee H, Wolfenden L, Yoong SL, Robson E, McAuley JH, Hartvigsen J, Williams CM. Musculoskeletal conditions may increase the risk of chronic disease: a systematic review and meta-analysis of cohort studies. BMC Medicine 2018;16:1673. Hartvigsen J, Hancock MJ, Kongsted A, et al. What low back pain is and why we need to pay attention. Lancet 2018; 391: 235667. The musculoskeletal system provides form, stability, and movement to the human body. It consists of bones (which make up the skeleton), muscles, tendons, ligaments, joints, cartilage, and other connective tissue. The term "connective tissue" is used to describe the tissue that supports and binds tissues and organs together. Its chief components are collagen and elastic fibers, which are composed of different proteins.The musculoskeletal system undergoes many changes as people age (see Effects of Aging on the Musculoskeletal System).Test your KnowledgeTake a Quiz!Author: Gordana Sendi, MDReviewer: Jana Vaskovi, MDLast reviewed: November 03, 2023Reading time: 28 minutes Musculoskeletal system The musculoskeletal system (locomotor system) is a human body system that provides our body with movement, stability, shape, and support. It is subdivided into two broad systems: Muscular system, which includes all types of muscles in the body. Skeletal muscles, in particular, are the ones that act on the body joints to produce movements. Besides muscles, the muscular system contains the tendons which attach the muscles to the bones. Skeletal system, whose main component is the bone. Bones articulate with each other and form the joints, providing our bodies with a hard-core, yet mobile, skeleton. The integrity and function of the bones and joints is supported by the accessory structures of the skeletal system; articular cartilage, ligaments, and bursae. Besides its main function to provide the body with stability and mobility, the musculoskeletal system has many other functions; the skeletal part plays an important role in other homeostatic functions such as storage of minerals (e.g., calcium) and hematopoiesis, while the muscular system stores the majority of the body's carbohydrates in the form of glycogen. This article will introduce you to the anatomy and function of the musculoskeletal system. Key facts about the musculoskeletal system Definition A human body system that provides the body with movement, stability, shape, and support Components Muscular system: skeletal muscles and tendons Skeletal system: bones, joints; associated tissues (cartilage, ligaments, joint capsule, bursae) Function Muscles: Movement production, joint stabilization, maintaining posture, body heat production Bones: Mechanical basis for movements, providing framework for the body, vital organs protection, blood cells production, storage of minerals The muscular system is an organ system composed of specialized contractile tissue called the muscle tissue. There are three types of muscle tissue, based on which all the muscles are classified into three groups: Based on their histological appearance, these types are classified into striated and non-striated muscles; with the skeletal and cardiac muscles being grouped as striated, while the smooth muscle is non-striated. The skeletal muscles are the only ones that we can control by the power of our will, as they are innervated by the somatic part of the nervous system. In contrast to this, the cardiac and smooth muscles are innervated by the autonomic nervous system, thus being controlled involuntarily by the autonomic centers in our brain. The skeletal muscles are the main functional units of the muscular system. There are more than 600 muscles in the human body. They vary greatly in shape in size, with the smallest one being the stapedius muscle in the inner ear, and the largest one being the quadriceps femoris muscle in the thigh. The skeletal muscles of the human body are organized into four groups for every region of the body: Muscles of the head and neck, which include the muscles of the facial expression, muscles of mastication, muscles of the orbit, muscles of the tongue, muscles of the pharynx, muscles of the larynx, and muscles of theneck Muscles of the trunk, which include the muscles of the back, anterior and lateral abdominal muscles, and muscles of the pelvic floor Muscles of the upper limbs, which include muscles of the shoulder, muscles of the arm, muscles of the forearm and muscles of the hand Muscles of the lower limbs, which include hip and thigh muscles, leg muscles and foot muscles The fact that there are more than 600 muscles in the body can be quite intimidating. If youre tired of all the big, comprehensive anatomy books, take a look at our condensed muscle anatomy reference charts, which contain all the muscle facts in one place organized into neat tables! Structurally, the skeletal muscles are composed of the skeletal muscle cells which are called the myocytes (muscle fibres, or myofibrils). Muscle fibers are specialized cells whose main feature is the ability to contract. They are elongated, cylindrical, multinucleated cells bounded by a cell membrane called sarcolemma. The cytoplasm of skeletal muscle fibers (sarcoplasm), contains contractile proteins called actin and myosin. These proteins are arranged into patterns, forming the units of contractile micro-apparatus called sarcomeres. Each muscle fiber is enclosed with a loose connective tissue sheath called endomysium. Multiple muscle fibers are grouped into muscle fascicles or muscle bundles, which are encompassed by their own connective tissue sheath called the perimysium. Ultimately, a group of muscle fascicles comprises a whole muscle belly which is externally enclosed by another connective tissue layer called the epimysium. This layer is continuous with yet another layer of connective tissue called the deep fascia of skeletal muscle, that separates the muscles from other tissues and organs. This structure gives the skeletal muscle tissue four main physiological properties: Excitability - the ability to detect the neural stimuli (action potential); Contractibility - the ability to contract in response to a neural stimulus; Extensibility - the ability of a muscle to be stretched without tearing; Elasticity - the ability to return to its normal shape after being extended. Learn everything about the skeletal muscle structure with our articles, video tutorials, quizzes and labelled diagrams. Learn fasterSkeletal muscleExplore study unit The most important property of skeletal muscles is its ability to contract. Muscle contraction occurs as a result of the interaction of myofibrils inside the muscle cells. This process either shortens the muscle or increases its tension, generating a force that either facilitates or slows down a movement. There are two types of muscle contraction; isometric and isotonic. A muscle contraction is deemed as isometric if the length of the muscle does not change during the contraction, and isotonic if the tension remains unchanged while the length of the muscle changes. There are two types of isotonic contractions: Concentric contraction, in which the muscle shortens due to generating enough force to overcome the imposed resistance. This type of contraction serves to facilitate any noticeable movement (e.g. lifting a barbell or walking on an incline). Eccentric contraction, in which the muscle stretches due to the resistance being greater than the force the muscle generates. During an eccentric contraction, the muscle maintains high tension. This type of contraction usually serves to slow down a movement (e.g. lowering a barbell or walking downhill). Eccentric and concentric muscle contractions (diagram) The sequence of events that results in the contraction of a muscle cell begins as the nervous system generates a signal called the action potential. This signal travels through motor neurons to reach the neuromuscular junction, the site of contact between the motor nerve and the muscle. A group of muscle cells innervated by the branches of a single motor nerve is called the motor unit. The incoming action potential from the motor nerve initiates the release of acetylcholine (ACh) from the nerve into the synaptic cleft, which is the space between the nerve ending and the sarcolemma. The ACh binds to the receptors on the sarcolemma and triggers a chemical reaction in the muscle cell. This involves the release of calcium ions from the sarcoplasmic reticulum, which in turn causes a rearrangement of contractile proteins within the muscle cell. The main proteins involved are actin and myosin, which in the presence of ATP, slide over each other and pull on the ends of each muscle cell together, causing a contraction. As the nerve signal diminishes, the chemical process reverses and the muscle relaxes. A tendon is a tough, flexible band of dense connective tissue that serves to attach skeletal muscles to bones. Tendons are found at the distal and proximal ends of muscles, binding them to the periosteum of bones at their proximal (origin) and distal attachment (insertion) on the bone. As muscles contract, the tendons transmit the mechanical force to the bones, pulling them and causing movement. Being made of dense regular connective tissue, the tendons have an abundance of parallel collagen fibers, which provide them with high tensile strength (resistance to longitudinal force). The collagen fibers within a tendon are organized into fascicles, and individual fascicles are ensheathed by a thin layer of dense connective tissue called endotenon. In turn, groups of fascicles are ensheathed by a layer of dense irregular connective tissue called epitenon. Finally, the epitenon is encircled with a synovial sheath and attached to it by a delicate connective tissue band called mesotenon. Learn more about the microstructure of tendon in this study unit: Learn fasterDense connective tissueExplore study unit The main function of the muscular system is to produce movement of the body. Depending on the axis and plane, there are several different types of movements that can be performed by the musculoskeletal system. Some of the most important ones include: Flexion and extension: movement of decreasing or increasing the angle between the bones involved in the movement, respectively. This motion takes place in the sagittal plane around a frontal axis. An example of flexion is bending the leg at the knee joint, whereas extension would be straightening knee from a flexed position. Adduction and abduction: movements of bringing the parts of the body towards or away from the midline, respectively. These movements are carried out in the frontal plane around a sagittal axis. For example, abduction of the arm at the shoulder joint involves moving the arm away from the side of the body, while adduction involves bringing it back towards the body. Rotation is the movement in which a part of the body rotates around its vertical (longitudinal) axis in the transverse plane. This movement is defined relative to the midline, where internal rotation involves rotating the segment towards to the midline, while external rotation involves moving it away from the midline. Examples include lateral or medial rotation of the thigh. Supination and pronation are special types of rotatory movements usually used to describe the movements of the forearm. Supination is essentially a lateral rotation of the forearm which turns the palms anteriorly (if the arm is anatomical position) or superiorly, when the elbow is flexed. These movements are also sometimes used to describe movements in the ankle and foot, in which supination means rolling the foot outwards, while pronation means rolling the foot inwards. Both during movement and stationary positions, muscles contribute to the overall support and stability of joints. Many muscles and their tendons pass over joints and thereby stabilize the articulating bones and hold them in position.In addition, the muscles also play an important role in maintaining posture. While the movements occur mainly due to muscles intermittently contracting and relaxing, the posture is maintained by a sustained tonic contraction of postural muscles. These muscles act against gravity and stabilize the body during standing or walking. The postural muscles include the muscles of the back and abdominal muscles. Another important function of muscles is heat production. Muscle tissue is one of the most metabolically active tissues in the body, in which approximately 85 percent of the heat produced in the body is the result of muscle contraction. This makes the muscles essential for maintaining normal body temperature. Wondering whats the best way to learn and understand the functional anatomy of the muscles? Check out our 3D muscle anatomy videos! To improve your understanding of muscular system terminology, take a closer look at some commonly used roots, prefixes and suffixes related to the muscular system in the video below. How well do you know the main muscles of the body? Test your knowledge with our quiz in different difficulty levels! The adult human skeleton is composed of 206 bones and their associated cartilages. The bones are supported by ligaments, tendons, bursae, and muscles. The bones of the body are grouped within the two distinct divisions: Learn fasterSkeletal systemExplore study unit Bones are rigid structures made of calcified dense connective tissue. Bone tissue is composed of a mineralized bone matrix that consists of type 1 collagen fibers dispersed throughout the ground substance. The cellular component of the bones is represented by three types of specialized bone cells called osteocytes, osteoblasts and osteoclasts. The bones consist of two distinct layers that differ in histological appearance and characteristics; Compact (cortical) bone is the outer much denser layer of the bone which gives it its smooth, white, and solid appearance. The outer surface of the compact bone is covered with a layer of dense connective tissue called the periosteum. On its inner surface, the compact bone is covered with endosteum, which is the boundary between the compact and spongy bones. Spongy (cancellous) bone is the deep airy layer of the bone. Unlike the compact bone, spongy bone is highly vascularized and more metabolically active. It is typically found within the ends of long bones and in the vertebrae. In certain bones, like the hip bone, sternum or femur, the central part of spongy bone houses the bone marrow, which is the site of hematopoiesis in the adult. Learn fasterBone tissueExplore study unit Types of bones Bones can be classified according to their shapes as follows: Long bones have a tubular shape, with a longer longitudinal and a shorter transverse diameter. They are composed mostly of compact bone, while the spongy bone and bony marrow fill the ends of the bones. Examples of long bones include the humerus, ulna, tibia and clavicle. Short bones have a roughly cuboid or round shape, and only contain a thin layer of compact bone surrounding the spongy bone. Examples include the tarsal and carpal bones. Flat bones are mostly thin, flattened and usually curved. They contain two parallel layers of compact bones surrounding a layer of spongy bone. Examples include most of the skull bones, scapula, sternum and sacrum. Sesamoid bones are small, rounded unique types of bones that are embedded in muscle tendons where the tendon passes over a joint. The largest sesamoid bone in the body is the patella, but several other smaller sesamoid bones can be found in the hand and foot, usually in close proximity to the joints. Irregular bones do not fit into any of the other categories. Generally, irregular bones contain foramina through which soft tissue and neurovascular structures pass. Examples include the vertebrae, hip bone and some bones of the skull. Wondering how to cut time in learning the bones of the body? Try our skeletal system quizzes! A typical long bone consists of a long shaft (diaphysis) that extends into a neck (metaphysis) and head (epiphysis) on its proximal and distal ends. It also features various markings and formations that give passage to neurovascular structures, as well as the attachment sites to the ligaments and tendons. Some of those features include: Sulcus a shallow groove on the bone surface (e.g. radial sulcus of humerus) Condyle rounded articular area (e.g. lateral condyle of tibia) Epicondyle eminence superior to a condyle (medial epicondyle of femur) Crest ridge of bone (e.g. iliac crest) Facet smooth, flat area, usually covered with cartilage (e.g. articular facet on vertebrae) Foramen passage through a bone (e.g. foramen magnum on the occipital bone) Cartilage is a flexible connective tissue found in multiple organ systems of the body. Cartilage is composed of specialized cells called chondrocytes, collagen fibers and abundant ground substance rich in proteoglycan and elastin fibers. Cartilage is classified into the following types based on its composition: Hyaline cartilage is composed of type II collagen and an abundance of ground substance, which gives it a glossy appearance. It is the most abundant type of cartilage found in joints (articular cartilage), as well as the nose, larynx, trachea and ribs. Elastic cartilage is similar to hyaline cartilage but contains more elastic fibers. It is found in structures such as the pinna of the ear, auditory tube and epiglottis. Fibrocartilage is composed of plenty of collagen fibers type I and a smaller amount of ground substance. Examples of fibrocartilage include intervertebral discs, pubic and other symphyses. The musculoskeletal system specifically contains articular cartilage, a type of cartilage that lines the articulating surfaces of bones. The articular cartilage provides congruence to the articulating bones and allows them to bear weight and glide over each other with very little friction. Learn fasterHyaline cartilageExplore study unit Each bone of the musculoskeletal system is connected to one or more bones via a joint. Joints provide a fulcrum to the bones, on which they pivot and thereby allow movements of body parts. However, movement is not a necessary attribute of a joint as some joints do not move, such as joints between the bones of the skull. The integrity or stability of a joint is provided by several factors including the bony congruence and structures that cross the joint, such as tendons and ligaments. Based on the type of tissue that holds the neighboring bones together and the range of motion they exhibit, joints can be classified into the following: Synovial joints are freely mobile joints in which the bones are not in direct contact, but are separated by a potential space called the synovial cavity. The synovial cavity is lined by a synovial membrane that secretes the synovial fluid which nourishes and lubricates the articulating surfaces in order to reduce friction. The articulating bones in most synovial joints are lined with hyaline cartilage. These joints usually have a wide range of motion, which is defined by the joint capsule, the supporting ligaments and muscles that cross the joint. Examples of synovial joints include the knee, shoulder, sternoclavicular and elbow joints. Fibrous joints are the articulations in which the bones are connected by dense fibrous connective tissue. The bones in fibrous joints are firmly held together so that the joint allows negligible movement. Fibrous joints are found between the cranial sutures, the distal tibiofibular and cuboideonavicular joints. Cartilaginous joints are articulations in which the bones are connected by cartilage. The bones have a range of motion between synovial and fibrous joints. Cartilaginous joints are subdivided into synchondrosis (e.g. costochondral joints) and symphysis joints (e.g. pubic symphysis). According to the movements they allow and/or the shape of their articulating surface, the synovial joints can be further subdivided into 6 major types: Ligaments are fibrous bands made of dense regular connective tissue which are similar in structure to tendons. Unlike the tendons that connect muscles to bone, the ligaments connect bone to bone. Besides the musculoskeletal system, the ligaments are also found in many other parts of the body, where they usually stabilize and hold internal organs in place and transmit neurovascular structures. In the musculoskeletal system, ligaments stabilize the articulating bones and reinforce the joints. Depending on their anatomic position relative to the joint capsule, ligaments are classified into: Capsular ligaments are essentially thickenings of the joint capsule that form either elongated bands or triangular structures. These ligaments serve to reinforce the integrity of the joint capsule. An example of the capsular ligament is the iliofemoral ligament of the hip joint. Intracapsular ligaments are the ligaments that lie internal to the joint capsule. These ligaments reinforce the connection of the articulating surfaces of the joint, but allow a far wider range of motion than other ligaments. Examples include anterior and posterior cruciate ligament of the knee joint. Extracapsular ligaments are ligaments that lie outside the joint capsule. These ligaments provide the most stability to the articulating bones, and are important for preventing dislocations. Extracapsular ligaments can lie in close proximity (e.g. medial collateral ligament of the ankle joint) or a bit further from the joint capsule (vertebral ligaments). Bursae are small sac-like outpouchings of the joint cavity lined by synovial membrane. They are found around the joints, providing cushioning of the associated bones, tendons and muscles and reducing friction between adjacent structures. The majority of synovial bursae are located near the large joints of the arms and legs. For example, one of the bursae of the knee joint is the suprapatellar bursa, found superior to the patella, between the femur and the tendon of the quadriceps femoris muscle. The suprapatellar bursa allows for these structures to slide over each other without friction during flexion and extension of the knee joint. To improve your understanding of skeletal system terminology, take a closer look at some commonly used roots, prefixes and suffixes related to the skeletal system in the video below. Time for a skeletal system workout with our integrated quiz! The skeletal system serves a variety of functions. The bones give the shape to the body and provide the site of attachment to muscles, tendons, ligaments and cartilage. These tissues function together as a whole to generate a force that provides the biomechanical basis of movement. Due to its structural integrity, the skeletal system protects the internal organs, most importantly the brain, which is surrounded by the skull, as well as the heart and lungs, which are protected by the rib cage. Moreover, the skeletal system serves several metabolic functions. The bones are the storage site of important minerals, most notably calcium and phosphorus. This makes the bones essential for balancing calcium levels in the blood, which is regulated by adjusting the rate of bone resorption. Lastly, the bone marrow found in spongy bone is the site of hematopoiesis, which is a process of production of new blood cells. Cells that are produced in the bone marrow are red blood cells, platelets and white blood cells, such as monocytes, granulocytes and lymphocytes. We created a custom summary quiz about the anatomy and histology of the main features of the musculoskeletal system. You can adjust and filter individual structures to make this quiz your own! Learn fasterMusculoskeletal system: Custom quizStart quiz There is a variety of conditions that affect the muscles, bones, and joints. Disorders of the musculoskeletal system may range from diseases to minor physical disabilities. The following are some clinical conditions of the musculoskeletal system: Osteoporosis is a condition that affects bone strength (the word osteoporosis literally means "porous bones"). It is a condition in which the bones become fragile and brittle, leading to a higher risk of fractures than in normal bone. As a result, even a minor bump or accident can cause serious fractures. Osteoporosis is the bone of the old, especially, in women. The hard, rock-like quality of bone is dependent upon calcium. When too much calcium is dissolved from bones or not enough is replaced, bones lose density and are easily fractured. Estrogen, the female sex hormone, helps maintain proper calcium levels in bones. Once the ovaries stop producing the hormone, women are at higher risk of developing osteoporosis. A collapse of bony vertebrae of the spinal column results in loss of height and stooped posture. Hip fractures are a common occurrence. Sarcopenia is a syndrome characterized by progressive and generalized loss of skeletal muscle mass and strength with a risk of adverse outcomes such as physical disability, poor quality of life and death. Arthritis is a group of conditions affecting the joints. These conditions cause damage to the joints, usually resulting in pain and stiffness due to aging. Arthritis can affect many different parts of the joint and nearly every joint in the body. As an individual ages, the joint tissues become less resilient to wear and tear and start to degenerate. This degeneration manifest as swelling, pain, and often-times, loss of mobility of joints. Changes occur in both joint soft tissues and the articulating bones, a condition called osteoarthritis. A more serious form of disease is called rheumatoid arthritis. The latter is an autoimmune disease wherein the body produces antibodies against joint tissues causing chronic inflammation resulting in severe joint damage, pain and immobility. Muscular dystrophy is a group of muscle diseases that weaken the musculoskeletal system and hamper locomotion. Muscular dystrophies are characterized by progressive skeletal muscle weakness, defects in muscle proteins, and the death of muscle fibres (muscle cells) and tissue. It is a group of inherited diseases in which the muscles that control movement progressively weaken. The prefix, dys-, means abnormal, while the root, -trophy, refers to maintaining normal nourishment, structure and function. The most common form in children is called Duchenne muscular dystrophy and affects only males. It usually appears between the ages of 2 to 6 and the afflicted live typically into late teens to early 20s. Other conditions involving the musculoskeletal system include: Lupus erythematosus Myasthenia gravis Rotator cuff tear Tendonitis Carpal tunnel syndrome Osteomalacia All content published on Kenhub is reviewed by medical and anatomy experts. The information we provide is grounded on academic literature and peer-reviewed research. Kenhub does not provide medical advice. You can learn more about our content creation and review standards by reading our content quality guidelines. References: Moore, K. L., Dalley, A. F., & Agur, A. M. R. (2014). Clinically Oriented Anatomy (7th ed.). Philadelphia, PA: Lippincott Williams & Wilkins. Netter, F. (2019). Atlas of Human Anatomy (7th ed.). Philadelphia, PA: Saunders. Standring, S. (2016). Gray's Anatomy (41st ed.). Edinburgh: Elsevier Churchill Livingstone. Ross, Lawrence M; Lamperti, Edward D, eds. (2006). Thieme Atlas of Anatomy: General Anatomy and Musculoskeletal System. R.M.H McMinn: Last's anatomy (Regional and Applied), 9th edition, Ana-Maria Dulea (2014 Illustrations: Musculoskeletal system -Irina Mnstermann Eccentric and concentric muscle contractions (diagram) - Yousun Koh Articles within this topic: Videos within this topic: Musculoskeletal system: want to learn more about it?Our engaging videos, interactive quizzes, in-depth articles and HD atlas are here to get you top results faster.What do you prefer to learn with?I would honestly say that Kenhub cut my study time in half.Read more.Kim Bengochea, Regis University, Denver Unless stated otherwise, all content, including illustrations are exclusive property of Kenhub GmbH, and are protected by German and international copyright laws. All rights reserved. The musculoskeletal system is the body's support structure. It is a matrix of bones, muscles, and joints that provides stability and protection and allows you to move. The musculoskeletal system is dynamic and constantly remodeling itself to keep you healthy. Research shows that up to 40% of the musculoskeletal system's load-bearing capacity is lost within weeks of inactivity. The musculoskeletal system weakens with age, too, increasing the risk of injuries and musculoskeletal diseases like osteoarthritis. Regular exercise throughout your life is crucial for keeping your musculoskeletal system healthy. This article takes a closer look at the function and anatomy of the musculoskeletal system. It details a variety of conditions that can affect this system, along with tips to keep your musculoskeletal system healthy. MoMo Productions / Getty Images The musculoskeletal system, also known as the human locomotor system, is the framework of the body. It is controlled by the nervous system, and comprised of bones, muscles, joints, and the many connective tissues that bind them together. Among its many important functions, the musculoskeletal system:Gives your body shapeSupports the body's weightAllows you to moveShields vital organs from impact damageStores essential minerals like calcium and phosphorus, which are crucial for bone and cell maintenanceProduces red and white blood cells via bone marrowOperates breathing (respiration) via muscle contractions The musculoskeletal system is constantly regenerating throughout your life, and its health is profoundly influenced by physical activity. Living an active lifestyle not only enhances musculoskeletal functions, but also protects against musculoskeletal diseases. The musculoskeletal system is an interconnected network of features that each boast their own structures, functions, and roles. To understand how the musculoskeletal system works as a whole, you will need to be familiar with its parts. There are 206 bones in the adult human body. Bones consist of a hard outer part made of proteins (mostly collagen) and hydroxyapatite (mostly calcium and other minerals). The inner portion of bone, called trabecular bone, is softer than the hard outer cortical bone, but it still is necessary for maintaining bone strength. While the structure of all bone is the same, the bones perform various functions in the body:Bones provide structural support for the body.Bones form a protective armor around organs.Bones store the majority of calcium and phosphorus, which are essential for bone, teeth, and cell health.Bones have an inner cavity that contains bone marrow, where red blood cells, white blood cells, and other components of blood are produced. Bones undergo a process that is known as remodeling. Bone remodeling is a continuous process whereby old bone is gradually replaced by new bone. About 25% of trabecular bone and 3% of cortical bone are removed and replaced through the remodeling process each year. There are two kinds of muscle that are part of the musculoskeletal system: skeletal muscles and smooth muscles. The third type of muscle, cardiac muscle, is not part of the musculoskeletal system. Skeletal muscles are: Bundles of contractile fibers, meaning that they move various parts of the body by contractingAttached to bones and positioned in opposing groups around the joints. For example, muscles that bend the elbow are positioned opposite muscles that straighten the elbow.Controlled by the brain, operating voluntarily under a person's conscious direction Smooth muscles are:Involved in certain bodily functions that are not under a person's controlLocated around some of the arteries and contract to adjust blood flowLocated around the intestines and contract to move food and feces along the digestive tractControlled by the brain, but not voluntarily. The engagement of smooth muscle is based on bodily needs, not conscious control. There's more to muscles than keeping you strong. When you exercise, your skeletal muscles emit proteins called myokines that:Regulate body weightReduce inflammationIncrease insulin sensitivitySuppress tumor growthImprove cognitive function The ends of the bone that form a joint are covered with a connective tissue called cartilage. Normal cartilage is smooth, flexible, and tough. Cartilage is composed of collagen, water, and proteins called proteoglycans. Cartilage serves to: Absorb shock during activities like running, jumping, and other forms of impactReduce friction with the movement of a joint, preventing bones from rubbing togetherEnhance the resilience of bones and protect them from wearing down Cartilage lacks lymph nodes, blood vessels, and nervous tissue. While this makes cartilage resilient, the limited blood flow makes it less capable of repairing and renewing itself. Thus, disorders marked by the breakdown of cartilage, like osteoarthritis, can be severely painful and disabling. The joints are where the ends of two or more bones come together. While there are joints that do not move, such as the joints between the plates of the skull, most joints are capable of facilitating movement. There are two types of joints that facilitate movement: synovial joints and cartilaginous joints. Synovial joints are: The most common joint in humansAble to slide without friction, due to the slippery, lubricated cartilage that covers the ends of each bone at the jointNumerous in form and include ball-and-socket, condyloid, gliding, hinge, pivot, and saddle joints. The elbow joint and hip joint are examples of synovial joints. Cartilaginous joints are: Completely united by cartilage where the two bones meetMore rigid than synovial joints. Cartilaginous joints lack a joint cavity, which limits their movements. The pelvis is an example of a cartilaginous joint.Able to withstand high-impact activities like running and jumping due to the cushioning cartilage provides Joints are enclosed in a joint capsule which has a lining (synovium). Cells of the synovium produce synovial fluid which nourishes the cartilage and helps to reduce friction during movement. Ligaments are tough, fibrous bands of tissue that connect bone to bone. They are composed of collagen and elastic fibers, which give them a rubberband-like stretchability. Ligaments: Surround and support the joints, allowing movement in specific directionsEnsure the bones in a joint do not dislocate or twist too muchContain sensory nerves that monitor data from movements, and help regulate the stiffness of joints based on that data Ligaments are particularly vulnerable to damage caused by overuse, trauma, and disease. While they are capable of self-healing after an injury, the process tends to be slower compared to muscles and bones. Tendons are similar to ligaments, except rather than connecting bone to bone, tendons connect muscle to bone. These tough, fibrous bands of tissue are primarily made of collagen. Tendons primarily perform the following functions: Absorb the forces that muscles generate upon impactEvenly transfer those forces to bonesProtect muscles from injury Tendons are usually found within a sheath (the tendon sheath), which allows them to move friction-free. A tendon sheath has two layers: the supportive and protective fibrous tendon sheath, and the synovial sheath, which produces synovial fluid to lubricate joints. Bursae (the plural form of bursa) are small, fluid-filled sacs that: Cushion the spaces between the bones, tendons, and muscles near jointsAre mostly found next to large joints, such as shoulder, elbow, hip, and knee jointsMinimize friction between these structuresHelp absorb shock upon impact Bursae vary in size depending on their location. The largest bursa in the body is the subacromial respective subdeltoid bursa, located between the acromion, deltoid, and the rotator cuff tendons of the shoulder. Musculoskeletal conditions are the leading cause of disability worldwide, affecting at least 1.7 billion people. There are more than 150 musculoskeletal conditions, including the following: Musculoskeletal conditions affecting bones include the following: Osteoporosis is a condition in which bone density decreases, resulting in weak, brittle bones. People with osteoporosis have a greater risk of bone fractures. Most people with osteoporosis are post-menopausal women and men with low testosterone. Osteopenia is another condition marked by low bone density. Unlike osteoporosis, in which bone density decreases over time, most people with osteopenia never developed peak bone density to begin with. This may be due to genetic reasons, or conditions like celiac disease that affect the body's ability to absorb calcium. Fragility fractures affect roughly half of all women and one-quarter of all men at some point in life. Fragility fractures are fractures that occur when a person falls from standing height or less. An injury like this means that your bones are weaker than normal, typically due to another underlying condition like osteoporosis. The hip, spine, and wrist are the most common sites of fragility fractures. Traumatic fractures are fractures caused by force. They can happen to any person of any age, not just people with low bone density. Traumatic bone fractures are commonly caused by falls from higher heights, motor vehicle accidents, and direct blows. Traumatic fractures can happen suddenly, or they can occur over time (stress fractures) due to activities like running. The following musculoskeletal conditions affect muscles: Sarcopenia is the involuntary loss of muscle strength and mass, most often due to aging and lack of physical activity. Beginning at age 30, the body naturally starts to lose about 3% to 5% of muscle mass each decade. While this is normal, poor nutrition and lack of exercise can expedite muscle loss and result in sarcopenia. Muscle strain occurs when a muscle is overstretched, causing muscle fibers to tear. This is often called a "pulled muscle." Muscle strains range from mild, in which the muscle is tender but has not lost strength, to severe, in which the muscle separates from the tendon and loses function. Muscle strains most often occur during contact sports like football, and sports that require quick starts, like tennis. Muscular dystrophy is a group of genetic muscular diseases that causes progressive muscle loss. Muscular dystrophies worsen over time. Eventually, many people with muscular dystrophy lose their ability to walk. Some muscular dystrophies appear in childhood, while others start later in life. Various musculoskeletal conditions affect joints: Rheumatoid arthritis is a chronic inflammatory disease in which the immune system attacks its own tissues, causing inflammation around joints and sometimes organs. The condition causes pain, stiffness, and swelling in the joints. Most people with rheumatoid arthritis start to notice symptoms in their 30s to 50s. Psoriatic arthritis is another form of inflammatory arthritis that affects some people with psoriasis, an autoimmune skin and nail disease. Psoriatic arthritis causes joint pain, stiffness, and swelling, most commonly in the fingers and toes. There are several forms of psoriatic arthritis, such as symmetrical polyarthritis, which closely resembles rheumatoid arthritis. Gout is an inflammatory disease that occurs when there is too much uric acid in the body. This causes uric acid crystals to build up in joints. Usually, flares affect one joint at a time. Gout flares usually start suddenly and last for days to weeks at a time. Flares are followed by remission when there are no symptoms.Low back pain is the most common musculoskeletal condition, affecting at least 619 million people worldwide. It is the leading cause of disability and is most prevalent in women ages 50 to 55 years. Low back pain may begin suddenly or develop gradually. The exact cause of low back pain is unclear in about 90% of cases. You can't prevent every musculoskeletal injury or disease. But you can take steps to keep your musculoskeletal system strong and reduce your risk of preventable conditions:Quit smoking: Smoking is linked to numerous musculoskeletal conditions, including low bone density, increased fracture risk, and increased risk of rheumatoid arthritis and other joint diseases.Stretch: Stretching reduces muscle tension, making your muscles, joints, and ligaments more resilient to stress and reducing your risk of injuries. Stretching also increases blood flow, helping your muscles rebound quicker from injury, inflammation, and exercise.Strength train: Strength training increases bone density and muscle mass and reduces the risk of osteoporosis. Strength training also improves balance, reducing the risk of falls.Keep blood pressure and cholesterol at safe levels: Cardiovascular and musculoskeletal health are closely intertwined. Having high blood pressure and high cholesterol both prolongs inflammation and makes it difficult for the body to recover from it.Maintain a healthy weight: People with increased body mass indexes (BMIs) have a greater risk of lower limb injuries, especially to the knees and ankles. They are also less likely to engage in regular exercise, which further increases the risk of poor cardiovascular health and widespread inflammation.Get proper sleep: Poor sleep is a common problem in people experiencing musculoskeletal conditions. Research shows that people with both musculoskeletal conditions and sleep issues experience more severe pain, greater disability, and are less physically active compared to people with musculoskeletal conditions who get good sleep.Practice good posture: Poor posture can have a profoundly negative impact on your musculoskeletal health over time. People with poor posture are more likely to have back pain, spinal dysfunction, and joint degeneration.Protect your body: Preventable injuries due to vehicular and workplace accidents are a major cause of musculoskeletal injury. Wear a helmet when doing activities like horse riding, rock climbing, or bicycling, and wear a seatbelt any time you are in a vehicle.Ask about your medications: Many medications can result in bone loss over time, and increase the risk of osteoporosis. When prescribed a medication, ask your provider if it is associated with bone loss. If so, your provider may also prescribe a medication that increases the rate of bone formation in the body. The musculoskeletal system is an intricate network of bones, muscles, tendons, ligaments, and other connective tissues. In addition to giving your body its shape, the musculoskeletal system functions like armor, protecting your organs and preventing injuries. Some musculoskeletal conditions, like osteopenia, cannot be prevented. Others, like osteoporosis, can be slowed or prevented by keeping your musculoskeletal system healthy. You can reduce your risk of musculoskeletal issues by making lifestyle changes like exercising regularly, getting good sleep, and practicing good posture. The musculoskeletal system is designed primarily for locomotion, movement, and performance of functional physical tasks and to mechanically support and protect the bodys organs. The system consists of muscles and tendons, ligaments, bones, joints, intervertebral discs, and their associated tissues such as synovial capsule, cartilage, fascia, and other fibrous tissues. However, these tissues should not be considered in isolationtheir function depends on complex neurologic, biomechanical, and physiologic interactions. This chapter will discuss the biology of musculoskeletal tissues and their responses to injury and rehabilitation, and will introduce the complex interactions between the musculoskeletal system and the rest of the body as whole. Finally, an overview of common musculoskeletal ailments from a variety of body parts will be presented as examples of these principles.A more detailed review will be provided in Section III: Ambulatory Care: Sports, Musculoskeletal, and Pain Medicine of this textbook.Skeletal muscle comprises 40 to 45% of the total body mass, converting chemical energy derived from food intake into generation of mechanical force.1 Muscles also contribute to essential body functions such as generation of heat; blood glucose regulation; and storage of lipids, carbohydrates, and amino acids.2 Muscles typically attach to bones with strong tendons, the fibers of which branch deep within the muscle bellies. Tendons consist of bundles of collagen that form sequentially larger fascicles. These are often covered by synovial tissues that bathe the tendon in a thin layer of tenosynovial fluid for lubrication and nutrient delivery. Others are covered only by muscular tissue or a dense sheath of connective tissue known as peritenon. Most muscular strain injuries occur at the muscletendon junctions. These can be toward the end of the muscle belly where it tapers to become predominantly tendon tissue or deep within the muscle along the tendon fibers. Tendons themselves are also commonly injured at the bony attachments (entheses) and within areas of particular high stress (i.e., where they wrap around bony prominences) or in areas of low vascularity such as the mid-substance of the Achilles tendon.Ligamentous tissues connect bone to bone. In the process, they form joint capsules, provide stability, and assist with energy conservation. Examples include knee collaterals, which are firm and minimally elastic, providing structure stability, and the shoulder capsular (glenohumeral) ligaments, which are thin and pliable and allow for a large range of motion. The iliofemoral (Y) ligament provides support in standing and therefore allows reduced muscular activity. It controls external rotation in flexion and both internal and external rotation in extension; this stores energy as the hip goes into extension, allowing for more efficient gait.3Cartilaginous tissue cushions the spaces between bones and provides a smooth surface to reduce friction within joints. Two major cartilage types are hyaline and fibrocartilage. Both are matrices consisting of living cells (chondrocytes); a nonliving framework supports the chondrocytes and provides for the tissues mechanical properties. In response to injury, fibrocartilage can be formed and fills in gaps created within hyaline cartilage, but is without the ideal mechanical properties of the native tissue. Articular cartilage is particularly good at cushioning against impact forces, but is susceptible to injury from shear forces. Therefore, biomechanical abnormalities that result in shear forces across joints (i.e., malalignment, ligament laxity, and underlying bony injury) predispose joints to loss of cartilage and degenerative joint disease.Dysfunction due to disuse is also common as flexibility and strength diminish rapidly with immobilization. Deconditioning also affects the cardiovascular, respiratory, neurologic, and skeletal systems. Lack of mobility and pain with movements may also result in decreased community ambulation and therefore more social isolation. Social isolation, sleep deprivation, or even pain itself may lead to psychological stress and depression, potentiating chronic pain syndromes. Decreased effectiveness of the cardiopulmonary system as a result of deconditioning leads to decreased exercise tolerance, potentiating muscular atrophy and osteopenia. The human body is thus dependent on the musculoskeletal system to not only provide a functional capacity, but also plays a significant role in maintenance of physiological and neuropsychological homeostasis.The body is a linked system of interdependent segments, often working in a proximal-to-distal sequence to perform a desired action at the distal segment.4 Hence biomechanical dysfunction in one body region is capable of causing injury at a distance, a concept otherwise known as kinetic chain.5 The concept of kinetic chain should be considered when assessing many of the common musculoskeletal syndromes encountered in clinical settings. Assessment of shoulder impingement syndrome would be incomplete without additional consideration of scapular stability, cervical and upper torso posture, and even lower extremity dysfunction, especially for overuse or repetitive stress injuries.The musculoskeletal system is a multicomponent system composed of muscle, connective tissue, tendon, ligament, and bone vessels.6 Damage to tissues initiates a cascade of events leading to the inflammatory and repair process. If tissue injury is severe or chronic, healing may not be accomplished with natural regeneration. Chronic inflammation stimulates scar formation and is the predominant healing process that occurs with severe injury (extensive damage to the extracellular matrix). Fibrosis is characterized by the extensive deposition of collagen that occurs under these conditions. Adequacy of tissue healing may be affected by both systemic and local factors. Systemic factors include age, psychological stress, alcohol consumption, smoking, nutrition status, obesity, metabolic status (e.g., diabetes mellitus), medications, circulatory status, and hormones (e.g., glucocorticoids inhibit collagen synthesis).7 Local factors include vascular supply/oxygenation, infection, mechanical factors (early or excessive motion of injuries may delay healing), location, and type of injury. Even after completion of the healing process, ongoing pain and dysfunction commonly persist. For example, the fibrosis that occurs after a hamstring strain leads to changes in muscle length, altering optimal relationships and decreasing ability for maximal muscle contraction. This has been postulated as a mechanism for recurrent muscular strains.8,9A variety of risk factors are associated with musculoskeletal injuries and may be categorized as either extrinsic or intrinsic. Extrinsic risk factors are external or environmental characteristics outside of the immediate anatomic/biological system that influence a persons injury risk.10 Extrinsic risk factors include use or misuse of protective equipment, skill level, work tasks, or weather conditions. Intrinsic risk factors are characteristic of a biological or psychological nature that may predispose an individual to injury. A nonexhaustive list of intrinsic risk factors includes age, sex, previous injury and adequacy of rehabilitation, aerobic fitness, body size, limb dominance, flexibility and laxity, muscle strength, imbalance and reaction time, central motor control, psychological and psychosocial factors, mental ability, postural stability, and anatomic alignment/morphology. Extrinsic factors may interact with predisposing intrinsic factors to increase likelihood of injury.11Risk factors can be further subdivided into modifiable and nonmodifiable factors. Although it is important to acknowledge and study the presence of nonmodifiable risk factors, it is also important for the clinician to identify modifiable ones, and a complete understanding of mechanism of injury is required, including the concept of kinetic chain. Identifying and addressing modifiable risk factors is key to prevention and treatment of musculoskeletal injury.The shoulder is a complex joint that sacrifices stability for mobility. The rotator cuff musculature contributes to dynamic stability of the glenohumeral joint. The other main articulations are the acromioclavicular (AC) joint and the scapulothoracic joint.Due to its complexity, as well as possible referred pain from the cervical spine, identification of the pain-generating structure in the shoulder may prove challenging. Fortunately, treatment of the various syndromes often overlaps. Goals of a physical therapy program are to normalize scapular stability, posture, and strengthening/stabilization. Treatment of pain is often necessary to facilitate therapy. This is usually possible with analgesic (including nonsteroidal anti-inflammatory medications) and intra-articular steroid/anesthetic injection (which also may aid with diagnosis).AC joint pain commonly localizes onto the superior aspect of the shoulder. Symptomatic AC joint pain will demonstrate focal tenderness on the joint itself and a positive scarf test (cross-arm adduction test). Imaging may also demonstrate degenerative changes or traumatic osteolysis of the clavicle, especially in individuals who do excessive overhead lifting.This bursa provides cushioning and lubrication within the confines of the subacromial space. Pain and inflammation may result from impingement of the bursa and rotator cuff underneath the acromion. Surgical intervention with acromioplasty and repair of associated rotator cuff tears may be warranted.Chronic overuse or direct injury to the rotator cuff musculature may result in varying degrees of injury and functional deficit. The supraspinatus, followed by the infraspinatus tendon, are most commonly affected. Patients typically present with weakness on active abduction and/or external rotation. Small rotator cuff tears often can be managed conservatively. Full-thickness injuries should be addressed with surgical repair promptly to avoid tendon retraction. Severe chronic full-thickness tears with retraction may also be managed conservatively, depending on the patients functional needs. In some instances, radiographic imaging of the shoulder may demonstrate superior migration of the humeral head as a result of the absence of the supraspinatus tendon (Fig. 41).Rotator cuff tear. X-ray demonstrating superior migration of the humeral head. (Photo contributor: Nicole Richman, MD)Presents after rotator cuff injury, periods of immobilization, or idiopathically. Diabetic patients, particularly with poor glucose control, are more likely to develop this condition. It initially presents with severe pain and progressive stiffness over a 9-month period followed by a frozen phase for 9 to 15 months and a thawing phase over a period of up to 2 years.12There are three articulations within the elbow: humeroulnar, humeroradial, and proximal radioulnar joints, which aid in flexion, extension, supination, and pronation. When the arm is fully extended, there is normally an anatomic valgus alignment (carrying angle), which is greater in women. The common extensor tendon origin is located at the lateral epicondyle, while the common flexor tendon origin is located at the medial condyle.The name implies an inflammatory process and is thus a misnomer, as the pathology is tendinosis, most commonly resulting from microtears of the extensor carpi radialis brevis tendon. Pain over the epicondyle and weak grip strength are common complaints and are reproduced on examination with resisted wrist extension. Conservative treatment may include rest; a tennis elbow brace, which unloads the common extensor origin; anti-inflammatory medications; and modalities such as strengthening. Corticosteroid injections may prolong healing and result in worse long-term outcomes.13 Other treatments such as dry needling, prolotherapy, and platelet-rich plasma (PRP) are showing promise; however, further studies are needed to establish efficacy. Surgical intervention may be required if conservative treatments fail.With medial epicondylitis, the most prominently affected tendons are the origins of the flexor carpi radialis and pronator teres (in contrast to lateral epicondylitis in which the extensor tendons are affected). Mild ulnar neuropathy may also develop. Treatment is similar to that of lateral epicondylitis, and surgical intervention is rarely indicated.Cubital tunnel syndrome is the second most common peripheral nerve entrapment syndrome after carpal tunnel syndrome. Patients present with weakness in the ulnar nerveinnervated muscles of the hand, as well as with sensory deficit in the ulnar nerve distribution. Electrophysiologic studies may be helpful with diagnosis. Cervical nerve root compression should also be considered.There are eight carpal bones arranged in two rows (Fig. 42A and B). The articulation between the rows is referred to as the midcarpal joint. There are five carpometacarpal (CMC) joints, five metacarpophalangeal (MCP) joints, four proximal

interphalangeal (PIP) joints, four distal interphalangeal (DIP) joints, one interphalangeal joint (IP) in the thumb, and a distal radial ulnar joint (DRUJ). The triangular fibrocartilage complex (TFCC) is located between the distal ulna and carpal bones and acts as the primary stabilizer of the DRUJ. Normally the wrist functions in flexion, extension, and radial and ulnar deviation.Bony architecture of the hand and wrist. (A) Bones of the hand and digits. All rays have metacarpophalangeal (MP) joints. The fingers have proximal and distal interphalangeal joints (PIP and DIP), but the thumb has a single interphalangeal (IP) joint. (B) Bones of the wrist. The proximal row consists of the scaphoid, lunate, and capitate. The distal row bones articulate with the metacarpals: the trapezium with the thumb, the trapezoid with the index, the capitate with the middle, and the hamate with the ring and small. The pisiform bone is a sesamoid within the flexor carpi ulnaris tendon. It overlaps the triquetrum and hamate but does not contribute to a carpal row. CMC, carpometacarpal; TFCC, triangular fibrocartilage complex. (Reproduced with permission from Lifchez SD and Kelamis J. Surgery of the Hand and Wrist. In: Brunicardi F, Andersen DK, Billiar TR, Dunn DL, Hunter JG, Matthews JB, Pollock RE, eds. Schwartzs Principles of Surgery, 10e New York, NY: McGraw-Hill; 2015.)This is syndrome is the most common peripheral mononeuropathy.The carpal tunnel is a fixed space surrounded by the flexor retinaculum and contains nine flexor tendons and the median nerve. Being a fixed space, any inflammatory or mechanical process leads to median nerve compression and furthers the cycle of inflammation. Patients typically present with pain and paresthesia in the median nerve distribution (radial three and a half digits of the hand), with symptoms most prominent at night. Electrophysiologic studies are diagnostic and helpful in determining severity of nerve damage. Risk factors include female gender, pregnancy, metabolic disorders, repetitive stress, and prior wrist fracture. Conservative treatment includes activity modification, night splinting, anti-inflammatory medications/modalities, nerve-stabilizing medications, and corticosteroid injections. Surgical intervention with carpal tunnel release is indicated for cases unresponsive to conservative measures or those with neural deficits.Osteoarthritis (OA) at the first CMC joint (base of the thumb) is the most common arthropathy of the wrist/hand. Diagnosis is established by symptom location, grind test (pain with axial loading of thumb CMC joint), and correlation with x-ray. De Quervains (first extensor compartment) tenosynovitis should be included in the differential diagnosis. Treatment includes anti-inflammatory medications and modalities, thumb splinting, and corticosteroid injection. Surgical reconstruction or fusion may be necessary.The wrist and hand can be affected by both rheumatoid and osteoarthritis. In rheumatoid arthritis symmetrical swelling of the MCP and PIP joints occurs. Long-standing disease results in ulnar deviation of the fingers, dorsal subluxation of the ulna, ulnar styloid erosion, and finger deformities. X-rays demonstrate periarticular osteopenia and erosions. Conversely, osteoarthritis is a noninflammatory process that results in articular cartilage deterioration and osteophytes at the bone margins. Patients can exhibit Heberdens nodules at the DIP joints and Bouchards nodules at the PIP joints (Fig. 43). There is usually tenderness over the affected joint and crepitus with range of motion, but stiffness often improves with 10 to 15 minutes of motion. Plain films aid in diagnosis, but are often not necessary. Treatment for all forms of hand arthritis includes lifestyle modification, nonsteroidal anti-inflammatory drugs (NSAIDs), bracings, and therapy. For inflammatory (rheumatoid) arthritis disease-modifying antirheumatic drugs (DMARDs)/biologic agents and joint replacement are common treatments.

Musculoskeletal documentation example. Musculoskeletal assessment data. What is included in a musculoskeletal assessment. How to document musculoskeletal assessment. Musculoskeletal assessment documentation sample. Musculoskeletal nursing assessment documentation example. What is a musculoskeletal assessment.