



RESEARCH PRIORITIES

FOR THE

UNIFIED MUSCULOSKELETAL RESEARCH AGENDA

- ➔ **Arthritis: Osteoarthritis and Inflammatory Arthritis**
- ➔ **Major Limb Trauma**
- ➔ **Osteoporosis and Bone Quality; especially fractures in the elderly**
- ➔ **Soft Tissue Injuries**
- ➔ **Spinal Disorders**
- ➔ **Childhood Musculoskeletal Conditions**

Developed by the Council on Research and Scientific Affairs of the American Academy of Orthopaedic Surgeons (AAOS), in cooperation with the Council of Musculoskeletal Specialty Societies (COMSS), the Orthopaedic Research Society (ORS), the Orthopaedic Research and Education Foundation (OREF), the Bone and Joint Decade 2002-2011, and with input from the American College of Rheumatology (ACR). Supported by individual members of COMSS, including, (in alphabetical order): American Association for Hand Surgery (AAHS), American Association of Hip and Knee Surgeons (AAHKS), American Shoulder and Elbow Surgeons (ASES), American Spinal Injury Association (ASIA), Association of Children's Prosthetic-Orthotic Clinics (ACPOC), Bones Society, Inc., Cervical Spine Research Society (CSRS), Hip Society, J. Robert Gladden Society (JRGS), Knee Society, Limb Lengthening and Rehabilitation Society (LLRS), Musculoskeletal Tumor Society (MSTS), North American Spine Society (NASS), Orthopaedic Rehabilitation Association (ORA), Orthopaedic Trauma Association (OTA), Pediatric Orthopaedic Society of North America (POSNA), Ruth Jackson Orthopaedic Society (RJOS), and Scoliosis Research Society (SRS).



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TYPES OF RESEARCH

B BASIC RESEARCH

Basic Research: answers fundamental questions on the physical, chemical, and functional mechanisms of life processes and disease. It provides the building blocks upon which other types of research are based, but is not necessarily disease specific.

C CLINICAL RESEARCH

Clinical Research: is conducted with human subjects, or on material of human origin such as tissue and specimens, with an investigator who interacts directly with human subjects.

T TRANSLATIONAL RESEARCH

Translational Research: translates knowledge from basic research into new or improved methods to treat and prevent disease; translates clinical insights into hypotheses that can be validated in the lab.

H HEALTH SERVICES RESEARCH

Health Services Research: examines access to, and the use, costs, quality, delivery, organization, financing, and outcomes of health care services to produce new knowledge about the structure, processes, and effects of health services for individuals and populations.

What is the Unified Musculoskeletal Research Agenda?

The mission of the Unified Musculoskeletal Research Agenda is to advance science and research in musculoskeletal care through a unified advocacy strategy on the part of leaders in the orthopaedic research community. These Research Priorities are a communication tool for organizations, such as the American Academy of Orthopaedic Surgeons (AAOS), the Council on Musculoskeletal Specialty Societies (made up of twenty-two orthopaedic specialty societies), the Orthopaedic Research and Education Foundation (OREF), and for individual researchers. They can share this information when they talk with policy makers and legislators in Washington, patient advocacy groups, foundations, and other potential donors about the musculoskeletal conditions with the greatest burden to society. Using this document, they can speak in one voice about the research that needs to be done.

The Bone and Joint Decade

This project is part of the Bone and Joint Decade 2002-2011 initiative, which has been endorsed by the United Nations, 58 governments, and 750 healthcare organizations worldwide. In the U.S., the initiative has been endorsed by more than 100 patient and healthcare professional organizations, all 50 States, and officially proclaimed by President Bush. This is a global initiative aimed at raising awareness and reducing the burden of musculoskeletal disease on society and advancing research in prevention, diagnosis, and treatment of musculoskeletal conditions.

ARTHRITIS

BURDEN OF DISEASE:

- ➔ There are more than 100 different types of arthritis, with Osteoarthritis and Rheumatoid (inflammatory) Arthritis being the most common.
- ➔ Arthritis is the leading cause of disability in the United States, affecting over 70 million (approximately 1 of every 3) adults. More than half of those affected are over the age of 65, but arthritis can also strike at younger ages.
- ➔ By the year 2030, it is projected that 41.4 million people aged 65 or older will have arthritis or chronic joint symptoms.
- ➔ The total cost to the US economy, including the loss of productivity, is over \$86.2 billion annually.
- ➔ Arthritis accounts for more than 39 million physician visits, 750,000 hospitalizations, and 9,000 deaths annually in the United States.

OSTEOARTHRITIS

- ➔ Osteoarthritis (OA), also known as degenerative joint disease, leads to pain, deformity, and loss of joint motion as protective cartilage within the joints is damaged and diminished, leaving sensitive bone exposed and vulnerable to abrasion and destruction.
- ➔ OA is the most common form of arthritis and a leading cause of disability worldwide. The incidence of OA increases with age, and disproportionately affects women.
- ➔ OA of the Knee is one of the five leading causes of physical disability in non-institutionalized men and women. OA of the Knee and OA of the Hip affect the ability to walk and climb stairs more than any other disease. The risk for disability attributable to OA of the Knee is as great as that attributable to cardiovascular disease and greater than that resulting from any other medical condition in elderly persons.
- ➔ OA of the Hip is a leading cause of hip pain, is considered the most debilitating form of OA, and affects women after menopause disproportionately. Progression of OA of the Hip is often rapid, leading to total hip replacement in three months to three years after first onset. One in 4 - 5 persons hospitalized for OA of the Hip is released to a long-term care facility or nursing home.
- ➔ The third leading site of osteoarthritis is the hand, where Heberden's nodes are a visible sign of the crippling effect of this disease. Other joint sites that may be involved include the shoulder, spine, knee, and feet and ankles.

DIRECTIONS FOR FUTURE RESEARCH:

- ➔ Explore the genetic, biological, and mechanical factors that influence the progression of arthritis. **(B, C)**
- ➔ Examine the molecular basis of osteoarthritis, biological repair processes, and bioengineering approaches to tissue regeneration with special emphasis on cartilage repair. **(B, C, T)**
- ➔ Study the interaction of materials and wear, specifically the interaction of the material with the host emphasizing early detection methodologies, prevention, and medical intervention. **(C, T)**
- ➔ Examine the effect of debris particles on tissues and investigate possible molecular markers of loosening and osteolysis. **(B, C)**
- ➔ Explore the effectiveness of alternative therapies in reducing symptoms of osteoarthritis. **(C, T)**
- ➔ Study the short and long-term effects of alternative bearing surfaces. **(C)**
- ➔ Evaluate new coatings and methods of implant fixation including use of bioactive materials. **(B, C)**
- ➔ Explore the benefits of chondral transplantation in preventing degeneration of joints. **(C)**
- ➔ Study joint kinematics around the hip, ankle, elbow, shoulder, wrist, and knee in normal, arthritic, and reconstructed states with the development of high-speed computational methodologies to stimulate natural and artificial joint performance. **(C)**
- ➔ Explore the role of novel imaging technologies on joint arthroplasty, including RSA, DEXA, surgical navigation, minimally invasive and robotic surgery. **(C, T)**
- ➔ Expand the use of Finite Element Analysis (FEA) to predict implant performance and identify and predict fundamental mechanisms of failure. **(C, T)**
- ➔ Define the individual connective tissue cell response to mechanical stimuli and the cellular pathways involved in the transduction of mechanical inputs. **(B, C)**
- ➔ Implement new strategies to minimize technical and medical complications, such as dislocation in total hip replacement, arthrofibrosis in total knee replacement, venous thrombosis, and embolism. **(C, T)**
- ➔ Develop new arthroplasties for ankles, first metacarpal phalangeal (MCP) joint, and wrist. **(B, C, T)**
- ➔ Study the relationship between quality and volume in total joint arthroplasty.
- ➔ Study the apparent underutilization of total joint arthroplasty in certain geographic areas and ethnic groups. **(H)**
- ➔ Develop public health strategies on the prevention of functional limitation and disability from OA. **(B, C, T, H)**
- ➔ Study the efficacy of pharmacologic versus non-pharmacologic interventions to delay disease progression and function decline. **(C, H)**
- ➔ Identify the determinants of pain in OA, develop treatment strategies, and study the effects of these treatments in clinical trials. **(B, C, T, H)**
- ➔ Develop more efficient imaging technologies for the detection of OA progression. **(B, C, T, H)**



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BURDEN OF DISEASE:**INFLAMMATORY ARTHRITIS**

- Arthritis literally means “inflammation of a joint.” In some forms of arthritis, such as osteoarthritis, the covering on the ends of bones gradually wears away, becoming frayed and rough, making joint movement painful. In other forms of arthritis, such as Rheumatoid Arthritis, the joint lining becomes inflamed as part of a systemic disease. These diseases are considered the inflammatory arthritides.
- The most common type of inflammatory arthritis is Rheumatoid Arthritis (RA).
- Other types of inflammatory arthritides include Gout, Psoriatic Arthritis (associated with the skin condition psoriasis), Viral or Post-Viral Arthritis (occurring after an infection), Reactive Arthritis, and Spondylarthritis, which affects the spine as well as the joints.
- Rheumatoid arthritis (RA) is characterized by widespread inflammation of joints and associated soft tissue structures, leading to pain, deformity, cartilage and bone damage, functional disability, and reduced health-related quality of life.
- RA is the most common type of inflammatory arthritis, with more than a twofold higher incidence in women than men.
- RA affects nearly 3 million Americans, with a peak incidence between 40 and 60 years of age. However, it can strike at younger ages, including adolescents.
- Within the first 5 years of RA, almost one-third of patients stop working due to progressive disability.
- One in four patients with RA undergoes total joint replacement.
- Juvenile Rheumatoid Arthritis is the most common form of arthritis in children, affecting 70,000 to 100,000 children under 16 years of age in the United States.



DIRECTIONS FOR FUTURE RESEARCH:

- ➔ Investigate and implement new strategies for early diagnosis and treatment of Rheumatoid Arthritis. **C,T,H**
- ➔ Analyze the variability of the disease by applying advanced genomic research technologies. **B,C,T**
- ➔ Investigate molecular mechanisms of joint inflammation, including those related to the formation of new blood vessels, synovial tissue proliferation, and production of cytokines, chemokines, and growth factors. **B,C,T**
- ➔ Explore the pathophysiology of articular cartilage and bone destruction. **B,C,T**
- ➔ Identify biomarkers for predicting disease severity at onset of symptoms as well as for monitoring the intensity of joint inflammation and the progression of joint destruction. **B,C,T**
- ➔ Identify mechanisms in severe states of RA leading to cardiovascular disease and malignancy. **B,C**
- ➔ Develop novel therapies based on mechanisms underlying the pathogenesis of joint inflammation and destruction. **B,C,T**
- ➔ Identify optimal treatment strategies for patients in the early stages of RA, including strategies for preventing the development of chronic, destructive disease. **C,T**
- ➔ Study predictors of individual treatment responses and their genetic and molecular basis. **B,C,T**
- ➔ Develop tissue engineering technology to permit cartilage and bone repair in patients with erosive disease. **B,C,T**



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MAJOR LIMB TRAUMA

BURDEN OF DISEASE:

- Major limb trauma includes fractures, crushing injuries, dislocations, open wounds, amputations, and injuries to tendons, blood vessels and nerves.
- 36.9 million musculoskeletal injuries are sustained annually in the U.S., accounting for 63.8% of all injuries. Injury is the leading cause of death in all age groups from 1 to 44 years of age.
- Injury costs account for:
 - 46% of emergency department visits (the largest component),
 - 16% of hospital outpatient visits,
 - 16% of ambulatory care visits, and
 - \$69 billion or 12% in total medical spending, second only to cardiovascular disease.
- Motor vehicle crashes result in 3.4 million injuries and 41,967 fatalities annually. They are the sixth leading cause of death in the U.S. and leading cause of death for children and young adults. An estimated 55% of frontal crash victims suffer fractures of the leg or foot.
- Every year, trauma-related orthopaedic conditions account for:
 - 1.9 million hospitalizations,
 - 11 million bed days, and
 - Over \$30 billion in total charges.



DIRECTIONS FOR FUTURE RESEARCH:

- ➔ Improve injury prevention including passenger safety in motor vehicle collisions. **H**
- ➔ Develop additional agents and delivery systems for molecular compounds and biophysical stimuli to accelerate normal healing. **B, C, T**
- ➔ Elucidate causes for delayed union and nonunion fractures and develop biologic mediators to reinitiate fracture repair. **B, C, T**
- ➔ Continue to improve trauma systems, triage, and delivery. **C, H**
- ➔ Elucidate the system effects of skeletal triage and delivery. **H**
- ➔ Elucidate the indications for nonoperative fracture care and improve management of specific skeletal injuries using techniques such as minimally invasive surgery. **C, T**
- ➔ Continue to improve implants used for fracture stabilization. **C, T**
- ➔ Improve outcome rates for fractures. Address improvements in the diagnosis and management of compartment syndromes and treatment of skeletal infection using local measures and systemic adjuncts. **C, T**
- ➔ Improve rehabilitation with workplace and activity re-entry including assessment of benefits of physical and occupational therapy protocols. **T, H**



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OSTEOPOROSIS AND BONE QUALITY

(especially fractures in the elderly)

BURDEN OF DISEASE:

- Osteoporosis is characterized by low bone mass and bone fragility that leads to osteoporotic fracture, especially of the hip, spine, and wrist. This serious and costly public health problem often results from minor trauma, especially in the elderly. Health care costs for osteoporosis and related fractures approach \$10 billion annually.
- 25 million Americans currently suffer from osteoporosis, and 80% are women. Millions more have low bone mass, leaving them susceptible to osteoporosis.
- 1.5 million fractures each year are associated with osteoporosis, which is a significant cause of deformity, disability, and pain, and can lead to death.
- At least 80% of hip and spine fractures for all women, and white males, between 65 to 84 years of age, are attributable to osteoporosis. Percentages for black males and men of other races are only slightly lower.
- A woman's risk of hip fracture is equal to her combined risk of breast, uterine, and ovarian cancer.
- Women are 4 times more likely to suffer from osteoporosis than men and their rate of fracture is 2 to 3 times that of men, but death rates in men one year post-fracture are higher.
- Falls are the second most common mechanism of injury due to trauma, following motor vehicle crashes. They account for 30% of emergency cases and are associated with the second largest number of hospital and ICU days.
- Hip fractures lead to 350,000 hospital admissions and 60,000 nursing home admissions annually. More than 4% of hip fracture patients die during their initial hospitalization, 24% die within a year of injury, and 50% lose the ability to walk independently.
- The spine is the most common site for the spread of cancer, which confounds the problems of osteoporosis. Lung cancer and breast cancer are the leading sources of tumors that metastasize (spread) to the spine.



DIRECTIONS FOR FUTURE RESEARCH:

- Explore the factors that contribute to the development of peak bone mass in both men and women in all ethnic groups. **B,C,T**
- Focus educational efforts on the maintenance of bone mass throughout life and secondary prevention such as medical therapies and physical activity training. **C,T,H**
- Explore the use of emerging technology such as vertebroplasty and kyphoplasty in the treatment of vertebral compression fractures. **C,T,H**
- Explore secondary causes of osteoporosis including all inflammatory arthritides (especially Rheumatoid Arthritis) and drug therapies (especially glucocorticoids). **B,C,T,H**
- Improve injury prevention programs for the elderly, especially fall prevention. **T,H**
- Improve post-fracture management, including the evaluation of the patient for osteoporosis, fracture fixation methods, improved inpatient management, and localized as well as systemic bone augmentation.
- Identify and improve noninvasive methods for determining fracture risk.
- Identify and evaluate the role of common analgesics and anti-inflammatory agents in fracture treatment. **B,C,T,H**
- Determine gene and matrix factors that affect bone mechanical strength and optimal fracture healing. **B**
- Develop appropriate, cost-effective methods to evaluate osteoporosis at the time of fracture (especially the hip and spine). **H**
- Identify and evaluate potential interventions to improve the outcome of patients with hip fractures. **C,T,H**
- Identify the parameters to be used to determine appropriate length of stay in acute and rehabilitative settings. **H**
- Develop criteria for transfer to acute and sub-acute rehabilitation centers, skilled nursing facilities, and/or discharge to home. **H**
- Identify and evaluate the prevention strategies and treatments for secondary causes of osteoporosis, including inflammatory arthritis (specifically Rheumatoid Arthritis) and drug-induced arthritis (specifically glucocorticoids). **C,T**



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SOFT TISSUE INJURIES

BURDEN OF DISEASE:

- Soft tissues, including ligaments, tendons, muscles, nerves, and cartilage, are vulnerable to damage in nearly every type of physical trauma, including violence, abuse, motor vehicle crashes, occupational accidents, sports and recreational injury, repeated overuse, and normal everyday activities in susceptible individuals.
- Soft tissue injuries include sprains, strains, contusions, tendonitis, bursitis, lacerations, ruptures, crushing, and compression.
- Soft tissue injuries and conditions account, annually, for:
 - 2 million hospitalizations, 9 million bed days, and more than \$28 billion in total charges,
 - 6.5 million outpatient visits,
 - 18 million emergency room visits, and
 - 64 million physician's office visits.
- There are 10 million sports injuries per year in the U.S. and 95% are a result of trauma involving soft tissues.
- Every year, 3 million Americans sustain knee injuries and 60% are a result of sports-related activity.
- The leading occupational injuries, ranked by annual medical, lost productivity, and administrative costs, include:
 - Sprains to the low back, knee, and upper arm;
 - Amputation, severance, or laceration of fingers; and
 - Dislocation, fracture, or rupture of lower leg, knees, ankle, or multiple body parts.
- Musculoskeletal complaints, including carpal tunnel syndrome, synovitis, tendonitis, tenosynovitis, and bursitis, account for 64% of all occupational illnesses.



DIRECTIONS FOR FUTURE RESEARCH:

- Increase the understanding of the causes of peripheral nerve compression and develop alternatives to surgical treatment. **C,T**
- Increase our understanding of Charcot arthropathy and diabetic foot insensitivity complications. **B,C**
- Expand the role of prefabricated engineered tissue in free tissue transfer and identify the links, if any, between factors that regulate microcirculation and those that mediate pain perception. **C,T**
- Develop improved methods of nerve repair and regeneration. **B,T**
- Investigate the molecular signals that control repair and growth in cells of the musculoskeletal system. **B**
- Develop synthetic replacements for muscle, ligament, tendon, and cartilage using tissue engineering techniques and or gene therapy. **C,T**
- Explore the knowledge of the interaction of the immune system and its role in transplantation of bone and ligaments. **B,C,T**
- Study the relative influences of osseous anatomy, ligamentous laxity, and sex hormones on musculoskeletal disorders. **B,C**
- Understand the role of physical activity in the development of tendon, ligament, and muscle. **C,T**
- Develop a better understanding of the particular fitness requirements for different genders, for different age groups, and for individuals with different physical disabilities. **C**
- Develop a better understanding of the impact of inactivity with respect to common pathologic mechanisms in musculoskeletal and neurological diseases or disorders. **C,T**
- Study pathomechanics of joint injury focusing on prevention and the development of more effective protective devices for particular sports and jobs where risks of physical impairment exist. **C,T**
- Develop training and conditioning programs that improve muscle reaction time, protective muscle stiffness, and performance. **C,T**
- Analyze the forces in normal tissues and the healing of soft tissues during in vivo activities. Develop new designs, based on this analysis, for improved repair and reconstruction procedures as well as for scientifically based rehabilitation protocols. **B,T**
- Identify the signaling pathways involved with muscle, tendon, and ligament injury, repair, and hypertrophy. **B**



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SPINAL DISORDERS

BURDEN OF DISEASE:

- Spine disorders include neck (cervical), mid-back (thoracic) and low back (lumbar) pain, nerve pain, sprains and fractures, degenerative disc disease and arthritis, spinal stenosis (narrowing of the spinal canal), tumors, and deformities.
- Back pain is the second most frequent reason for physician office visits, the fifth most frequent reason for hospitalization, and the third ranking reason for surgical procedures in the U.S. It is the most frequent cause of activity limitation in people under 45.
- Every year, back and spine conditions account for:
 - 1.6 million hospitalizations with 7 million bed days and \$26 billion in total associated charges,
 - 6.5 million emergency room visits,
 - 33 million physician office visits, and
 - 61% of all annual musculoskeletal bed days.
- Disc disorders are the leading cause of back pain and disability, accounting for 55% of all hospitalizations related to back pain.
- Of the 1.7 million annual nonfatal injuries and illnesses in private industry resulting in lost workdays, 25% are related to back complaints.
- In 2000, Medicare paid \$339 million for medical back problems and surgical spinal procedures combined. Total charges were over \$906 million.



DIRECTIONS FOR FUTURE RESEARCH:

- Improve the ability to diagnose spinal disorders, including the ability to localize the source of pain, evaluate motion segment instability, and evaluate the role of muscles and connective tissue on back pain. **C,T**
- Implement randomized controlled trials for surgical and nonsurgical treatment of back disorders. **C**
- Accurately define surgical indications and the natural history of nonsurgically treated spine conditions. **C,T**
- Explore new treatment methods and technologies for degenerative disc disease, including the use of artificial disc and nucleus, the use of growth factors and/or gene therapy to reverse the process of disc degeneration. **T**
- Study the etiology of spinal deformities such as idiopathic scoliosis with emphasis on screening programs and treatment alternatives. **C**
- Improve the treatment of spinal column injuries, including methods of fixation, and enhance the treatment of neurologic injury associated with spinal trauma.
- Understand the basic biological processes associated with spinal disorders, including the biological basis for fusion enhancement and the biological treatment of degenerative disc disease. **B**
- Study the biomechanics of spinal degeneration, motion segment, and clinical instability. **C**
- Improve the treatment of both primary and metastatic spinal column tumors.
- Study etiology of lower back and neck pain with goal of using novel medical interventions as well as treatment alternatives that may be useful in alleviating pain in the future. **C,T**



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CHILDHOOD MUSCULOSKELETAL CONDITIONS

BURDEN OF DISEASE:

- Trauma is one of the greatest public health problems for children and is the leading cause of mortality after the first year of life. It exceeds all other causes of childhood death combined.

- Childhood musculoskeletal conditions involve problems with the muscles and soft tissues, bones, joints, spine, and limbs and can be classified into:
 - 1) Trauma from accidents, abuse, and injury,
 - 2) Neuromuscular diseases,
 - 3) Developmental problems occurring spontaneously during growth,
 - 4) Genetic and congenital malformations, and
 - 5) Tumors and infections in bone and connective tissues.

- The overall cost of childhood musculoskeletal conditions is incalculable. Although some conditions can be treated, with a full restoration to active life, others can result in early death or progressive problems into adulthood, creating lifelong burdens for the individual and family.

- In 2000, childhood musculoskeletal conditions accounted for:
 - 160,000 hospitalizations, 3 million bed days, with over \$2 billion in total associated charges,
 - 300,000 outpatient visits, and
 - Over 2 million physician office visits.

- Congenital malformations are some of the most serious and costly of the childhood musculoskeletal conditions, with an estimated total cost of \$862 million in 1995. Musculoskeletal birth defects account for 7% of deaths due to congenital anomalies. They are the third most frequent cause of death in infants.



DIRECTIONS FOR FUTURE RESEARCH:

- ➔ Identify and define the action of the genes that regulate skeletal formation, growth, and development. **B**
- ➔ Elucidate the mechanisms by which these genes are regulated. **B**
- ➔ Discover the actions and interactions of cell-regulatory proteins and their target cells in normal and abnormal conditions. **B**
- ➔ Investigate the developmental biology of the musculoskeletal system with emphasis on bone and joint development and mechanism of regeneration. **B**
- ➔ Develop additional physiologic interventions for the correction of skeletal deformities and neuromuscular conditions including cerebral palsy and muscular dystrophies. **B,C,T**
- ➔ Design and conduct clinical trials to determine optimal therapeutic approaches to these conditions as new treatments are developed. **C,T**
- ➔ Understand the molecular heterogeneity of bone and soft tissue tumors in terms of characterization and response to therapy. **B,C,T**
- ➔ Investigate the role of genetics in bone tumors with emphasis on molecular staging, therapeutic targets, models development and use of gene chip (microarray) analysis. **B,C,T**
- ➔ Improve the use of bone allografts and prosthetic reconstruction in limb salvage for bone tumors. **C,T**
- ➔ Improve childhood injury prevention programs. **C,H**
- ➔ Develop rapid diagnostic tools for musculoskeletal infection. **C**
- ➔ Implement new strategies for early diagnosis and treatment of inflammatory disorders in children. **C,T,H**
- ➔ Study the predictors of individual treatment responses and their genetic and molecular basis for childhood inflammatory disorders. **B,C,T**



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CHILDHOOD MUSCULOSKELETAL CONDITIONS

Cerebral Palsy is a group of nonprogressive motor function disorders caused by lesions or anomalies of the brain. Its etiology is not well understood. It may result from low birth weight, illness, infection, or injury. It is the most prevalent physical disability originating in childhood, afflicting 750,000 individuals in the U.S., including about 10,000 newborns annually. The prevalence is 2.4 per 1,000 children ages 3 to 10 years and the incidence is increasing due to the survival of very low birth weight infants. Incidence is higher in black children, when compared to whites.

Child Abuse is a serious and significant source of injury to children. Approximately 2.4 million reports of child abuse are filed annually in the U.S., and 4,000 of these children die every year. Fractures are seen in almost 50% of child abuse cases, as are many soft tissue injuries. Firstborn children, premature infants, stepchildren, and handicapped children are at the greatest risk. Most cases of abuse involve children younger than 3 years.

Clubfoot is a congenital foot deformity with an incidence of 1 in 735 births. The incidence in males is twice that of females. If a family has one child with clubfoot, the risk in subsequent siblings is 3% to 4%. If one parent and one child in a family have clubfoot, subsequent children have a 25% chance of having clubfoot.

Developmental Dysplasia of the Hip is a disorder involving a range of hip problems, including instability, poor development, and dislocation of the hip. It most commonly affects the left hip in girls, infants born in breech presentation, Caucasians of northern European ancestry, Native Americans, or families with a history with the disorder. The disorder is not always detectable at birth, but incidence is estimated at 1 in 100 newborns with evidence of instability in the hip, and 1 to 1.5 cases of dislocation per 1,000 newborns.

Ewing's Sarcoma is the second most common bone malignancy in children, accounting for 5% of childhood bone tumors. Most tumors are found in the femur, tibia, or fibula. The 5-year survival rate has increased from 5% to 50% in the last thirty years.

Heredity Motor Sensory Neuropathies include Charcot-Marie-Tooth and Dejerine-Sota disorders. Charcot-Marie-Tooth disorder causes weakness and wasting away of legs, feet, and hands. It is a common disorder with an occurrence of 1 in 2,500 people and is the most common form of polyneuropathy.

Juvenile Rheumatoid Arthritis is the most common form of arthritis in children, affecting 70,000 to 100,000 children under 16 years of age in the U.S. It is an autoimmune disease in which the body attacks its own healthy cells and tissues.

Legg-Calve-Perthes Disease is a disorder affecting the hip in which the bone of the femoral head dies and collapses, leading to deformity and arthritis. It is most common among those age 4 to 8 years, and is four times more common in boys than in girls.

Motor Vehicle Accidents are the leading cause of death among children. Injuries are usually the result of being unrestrained in the car and therefore are preventable. The largest proportion of adolescent injuries is due to motor vehicle accidents and teens are the least likely groups to use seat belts. Two out of 5 teen deaths in the U.S. result from automotive accidents. The cost of crashes involving teen drivers (ages 15 - 20 years) was estimated at \$32.8 billion in 2000.

Muscular Dystrophies are characterized by progressive weakness and degeneration of the muscles. The two most common forms are Duchenne and Becker Muscular Dystrophy.

Duchenne Muscular Dystrophy (Meryon's Disease) is the most common childhood form of Muscular Dystrophy and the most common inherited muscle disease. It affects 1 in 3,500 males and causes progressive muscle weakness. Walking becomes impossible around age 10. Most affected individuals die in their thirties from cardiopulmonary problems.

Becker Muscular Dystrophy is very similar in its symptoms to Duchenne's, but the age of onset is later and

the symptoms progress more slowly. The ability to walk continues into the thirties and death tends to occur later.

Osteochondroma is the most common childhood benign skeletal tumor. It accounts for 20% to 50% of benign tumors and 10% to 15% of all tumors. Osteochondroma is caused by either a congenital defect or trauma to the growth plate.

Osteogenesis Imperfecta, also known as "brittle bone disease," is a group of rare genetic disorders affecting the connective tissues and characterized by extremely fragile bones that break easily. The disorder, typically diagnosed in infancy, afflicts an estimated 20,000 to 50,000 adults, children, and infants in the U.S.

Osteoid Osteoma is a benign bone tumor found in young, uncalcified bone, which causes pain and swelling. It tends to occur more often in boys. Half of the cases occur in the tibia or femur.

Osteomyelitis is an infection in bone, usually bacterial in origin, that affects about 1 in 10,000 children. It may result from open fractures and gunshot wounds and can lead to septic arthritis. Symptoms include pain, soft tissue swelling, bone tenderness, and malaise.

Osteosarcoma is the most common type of primary bone cancer and the sixth most common type of cancer in children, accounting for 5% of all childhood cancers. It begins in the bone and eventually spreads. Boys are twice as likely to be afflicted and most cases are in the knees.

Scoliosis is a common diagnosis, involving lateral curvature of the spine and afflicting 10% of adolescents. It could be the result of different diseases or conditions, including Spina Bifida, Cerebral Palsy, or Muscular Dystrophy. In 90% of cases, the cause is unknown. In severe scoliosis, misshapen ribs can reduce the amount of air the lungs can hold and may put stress on the heart. The incidence of curves that need treatment is 3 to 5 per 1,000.

Septic Arthritis is a common childhood condition in which bacteria, viruses, or fungi settle into the joint. Its etiology is unknown, and serious cases can result in joint destruction or death.

Slipped Capital Femoral Epiphysis is the most common hip disorder in adolescents and teenagers between the ages of 10 and 18. The cartilage plate (epiphysis) at the femur slips out of place and may result in deformity and arthritis.

Spina Bifida is a birth defect in which the vertebra do not form properly around the spinal cord, which can result in the leakage of spinal fluid or exposed spinal nerves. This can cause swelling and even paralysis. Spina Bifida is one of the leading developmental disabilities in the U.S. Incidence is 1 in every 2,000 live births, with an overall mortality rate of 25% in the first 25 years of life. Spina Bifida results from a neural tube defect during the prenatal period. In 1995, the direct and indirect costs for Spina Bifida were estimated at \$489 million.

Sports and Recreational Injuries, including bicycle riding, basketball (the leading cause of sports-related injuries), football, and roller sports, are the most prevalent cause of injuries to bones and muscles in children. There were approximately 1.5 million medically treated injuries for ages 5 to 14 years during 2000. About 45% of playground injuries are severe and could involve fractures, internal injuries, concussions, dislocations, or amputations. The 1995 estimated cost for recreational injuries in those age 14 years and younger is \$1.2 billion.

Trauma is one of the greatest public health problems for children and is the leading cause of mortality after the first year of life. It exceeds all other causes of death combined. Every year 20%-25% of children have an injury severe enough to require medical attention, miss school, and/or require bed rest. The incidence of trauma is higher in boys than in girls. Poverty increases injury rates. Mortality rates from injuries in children whose families have incomes below the poverty line are at least 2.6 times that of other children.



FOR MORE INFORMATION, PLEASE CONTACT THE AMERICAN ACADEMY OF ORTHOPAEDIC SURGEONS
RESEARCHINFO@AAOS.ORG / WWW.AAOS.ORG
 OR THE ORTHOPAEDIC RESEARCH AND EDUCATION FOUNDATION
WWW.OREF.ORG

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Knee Society	www.kneesociety.org
American Orthopaedic Foot and Ankle Society (AOFAS)	www.aofas.org
Orthopaedic Research Society (ORS)	www.ors.org
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Knee Society	www.kneesociety.org
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Orthopaedic Research Society (ORS)	www.ors.org
Limb Lengthening and Reconstruction Society	ksyzkek@yahoo.com

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Orthopaedic Research Society (ORS)	www.ors.org
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Scoliosis Research Society (SRS)	www.srs.org
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