SPINE-RELATED PAIN IN SPORTS MEDICINE

A brief review of evaluation and treatment strategies for sports-specific disorders.

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The spine is commonly involved in sports injuries. Although not the usual focus of a sports medicine practitioner, its importance should not be overlooked. Spinal conditions can have substantial effects on athlete's performance, as well as important implications of the propensity for neurological injuries. Athletic performance is dependent upon a stable spine with well-coordinated neuromuscular patterns of movements.[1-3] Bergmark studied the lumbar spine using a mechanical modeling approach and divided the musculature of the trunk into local and global systems.[4] He believed that the global system, which included muscles such as the rectus abdominis and erector spinae, transferred force between the thoracic spine and pelvis. The local system, which consists of muscles that act directly on the lumbar vertebrae, such as the mutifidi, maintains force control within the lumbar spine. Panjabi described a model addressing spinal instability in which he proposed the existence of three separate but interrelated subsystems that act to control intersegmental stability.[1,4] This model suggests that an injury affecting the passive subsystem could theoretically be at least partially compensated for through the enhancement of the function of the other subsystems.

The stable spine is maintained by three subsystems:

- passive subsystem (spinal column, eg., ligaments, vertebrae, disks) includes intrinsic spinal anatomy comprising vertebrae, intervertebral discs, facet articulations, joint capsules, and extensive ligamentous attachments;
- active subsystem (spinal musculature) includes the muscles and tendons acting on the intrinsic elements;
- neural control subsystem (eg., sensory receptors, cortical and subcortical controls) comprises afferent sensory receptors distributed throughout all tissues, an efferent arm, which executes motor actions, and a control center, which integrates sensorimotor function.

Coordination of these subsystems is critical to the generation of movement.

The functional model for the physiatric approach to the spine in sports is outlined in the 1997 World Health Organization definitions of impairment, activity, and participation.[4] These core principles include understanding spine biomechanics, flexibility, strength, conditioning, core strengthening, stabilization, and cross training. These core principles provide the building blocks for enhancing athletic performance. This applies to all levels of sports participation, from the weekend warrior to the elite athlete. Training to prevent injury and enhance performance defines rehabilitation treatment. Many athletes develop inefficient movement patterns due to asymmetries of flexibility and strength. By identifying and correcting these inefficiencies, the practitioner may help the athlete prevent injury, disability, and improve performance.

As society's emphasis on continued physical activity and athletics throughout the lifespan has increased, so have the knowledge and skill required by the community of health care providers involved in managing the related injuries. It is essential for all sports medicine providers to realize that a team approach (physicians, physical therapists, athletic trainers, coaches, etc.)—which takes advantage of the collective knowledge, talent, and expertise of all these specialists in a collaborative effort—affords the athlete the optimal conditions for successful return to sport.[1-22]

It is important to note that with most athletes up to 60% of the "overuse" type injuries are related to training errors. Interaction with the coach/trainer is critical in solving this problem. Pain will get the athlete into the clinic, but the tricky part can be figuring out exactly what is causing the pain. The old acronym RICE (Rest, Ice, Compression, & Elevation) along with NSAIDS can do a very nice job of decreasing/eliminating the chemical pain associated with the inflammatory response. However, the real challenge is to identify the underlying dysfunction.

A thorough physical exam, biomechanical assessment, and functional movement analysis can provide great insight into how the body moves and reveal any joint dysfunction and/or muscle imbalances. The muscle imbalance leads to changes in the length-tension relationships of involved muscles. This change in force coupling decreases neuromuscular efficiency and leads to more rapid fatigue. As the muscles fatigue there is often a biomechanical compensation which may overload tissues not used to that new stress. Eventually breakdown must occur and the athlete enters the cumulative injury cycle of pain.

With the heightened interest in personal fitness and athletic participation, the physician is expected to see a variety of sports-related injuries and must be able to recognize these conditions in order to institute prompt and proper management. A thorough history, physical examination, radiographic studies, laboratory studies and, occasionally, further imaging studies are essential to establish and confirm the appropriate diagnosis and institute correct and adequate treatment for the injured athlete. The mechanism of injury must be established in order to proceed on the correct path. Symptoms must be evaluated in detail and categorized for initial stimulus, location, intensity, and characterization of the pain pattern (the major symptom in overuse injuries). The primary purpose of the physical examination is to define precisely the anatomical structures involved in the overuse injury. With musculoskeletal injuries, the easiest way to localize the maximally painful area is to have the athlete assume the position of maximal discomfort and then to point out the most painful location, which usually involves stretching the involved muscle. Radiographic and other diagnostic testing are occasionally used to evaluate and often exclude other sources of more serious pathology. Diagnostic testing should never be used initially to make a diagnosis, but instead used as a supplement to the thorough history and physical examination.[1-22]

Epidemiology of Spinal-Related Pain in Athletes

The spine links the torso to the extremities. This link ensures a coordinated transfer of power from the ground through the body, producing movement and performance. Due to anatomic relationships, spinal elements are subject to tremendous stresses during athletic activity. In particular, the lumbar segments accept the greatest stress in the form of ground reaction forces, which are high due to gravitational effects and body weight. Pain episodes are typically related to one or two mechanisms: acute trauma or, more commonly, repetitive stress fatigue injury.

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In the general population, back pain is one of the most common complaints prompting physician visits. The lifetime prevalence of spinal-related pain in most population studies ranges 60-80%. Recovery from episodic acute back pain occurs in 70% of cases within 3 weeks, 90% within 3 months, and 95% within 6 months.[1-4] Chronic low back pain occurs in 4-5% of the general population. Up to 70% of patients have recurrent episodic back pain. Treatment costs and secondary disability-related costs create an enormous societal financial burden.

During athletic endeavors, the spine is subject to rapid, repetitive, and high-impact loading events. As the beneficial effects of exercise continue to be recognized and marketed, there is an increase in the number of athletes participating in higher-impact exercise and athletics. This trend has included senior participants and variable amounts of quality and quantity of training and pre-participation preparation. These factors have resulted in subsequent increases in the total number of injuries, including injuries to the spinal column.

Attempts at quantifying the incidence of spinal-related pain have been a difficult task. Most episodes of back pain in athletes resolve spontaneously, without specific treatment. This leads to an underreporting of the condition and difficulty in documenting the actual numbers, although numerous authors have estimated that approximately 10-15% of sports injuries are related to the spine.[1-4] Most studies comparing contact and non-contact sports at various levels of competition reveal soft tissue injuries as self-limited. Those injuries with significant neurological sequellae are usually associated with direct axial forces, and are closely related to the mechanism of injury as opposed to a specific sport.

The lumbar spine is the most frequent site of injury in gymnastics, football, weightlifting, wrestling, dance, rowing, swimming, amateur golf, and ballet.[1-4] In professional golf and aerobic dance, the lumbar spine is the second most common site of injury. Lumbar spine pain is also a significant source of disability in general dance, skating, tennis, baseball, jogging, cycling, and basketball. Sport-specific epidemiologic studies have shown that 30% of football players and 15% of basketball players have lost time from play due to low back pain. Among professional men's tennis players, 38% have missed at least one tournament because of low back pain. In a ten-year review of traumatic cervical spine injuries in children, 10% were attributed to athletic events. Similar to recovery data from the general population, a significant majority of acute-onset back and neck pain in the athletic population are self-limited injuries that respond to conservative management. These recovery patterns are influenced by factors unique to the athletic population. Epidemiological studies suggest that a majority of back injuries in both athletes and non-athletes are soft tissue related.[1-4]

Adolescent and preadolescent athletes also face different challenges than the mature athlete. Skeletal immaturity, growth, decreased body mass, training, and nutritional deficiencies all set up a unique potential for spinal pathology. Discrepancies between bony and soft tissue growth and immature skeletal endplates can lead to increased problems with the posterior elements and discogenic sources. Pars defects are more commonly encountered in the skeletally-immature athlete, especially those undergoing repetitive lumbar hyperextension maneuvers.[1-4]

Sports-specific Spine Disorders and Rehabilitation[1-22]

Running and Spine Injuries

Biomechanics/Pathogenesis: Running activities typically require that the spine, especially the lumbar region, move through a limited range of flexion, extension, rotation, or lateral bending maneuvers. The most frequent and significant spine injuries directly related to running are due more to the repetitive axial or compressive loading of the spine that occurs during foot strike with each stride. Clinically, the most significant injurious affects from running appear to result from the highly repetitive axial compressive loads that occur at heel strike with each stride. Factors which may affect spinal pain include spine posture, lower extremity biomechanical changes, running shoe and insole materials, and significant leg length discrepancies.

Common Disorders: Disorders include myofascial sprain/strain, delayed-onset muscle pain, cervical/thoracic/lumbar disc herniations, radiculopathy or somatic pain referrals, piriformis and sacroiliac/facet joint pain syndromes, spine and sacral stress fractures, osteoarthritis, ligament/tendon injuries, spondylolysis or pars stress fractures.

Clinical Exam: Perform a focused exam of spine, pelvis, and lower extremities to determine an accurate diagnosis. Standing and jogging/running posture should also be performed, as well as a video-recorded gait evaluation by a trained specialist. Footwear and orthotic inserts should be evaluated to determine biomechanics. Diagnostic and radiological testing should be selectively evaluated, including possibly x-rays, ultrasound, bone scans, CT or MRI scans, bone density scans, single-photon emission computed tomography (SPECT), electrodiagnostics (EMG/NCS).

Treatment and Rehabilitation: Acute injuries should include cessation or reduction of jogging/running activities, cold/heat modalities, initiation of nonsteroidal anti-inflammatory or steroidal medications, following the RICE principle (rest, ice, compression, elevation). Subacute/chronic injuries should be treated with directed stretching/ flexibility/strengthening program; and occasionally a specialized physical therapy program. Interventional treatments, including fluoroscopic-guided spinal/pelvic injections following established guidelines, are well-documented in the literature and should be utilized, as required. Non-impact loading aerobic exercises and aquajogging and substitutional aerobic activities (elliptical cross-trainers or bicycling) are useful during rehabilitation. Other considerations include: foot orthotic prescriptions for select patients, footwear evaluation by a trained professional, and adjustments in running mileage or running surfaces.

Training and Prevention: Strategies include: limitations in total running mileage by the athlete, aerobic cross-training, obtaining well-fitting footwear and foot orthotics, running surface changes, spine/lower extremity/pelvic flexibility training, lower extremity/pelvic strengthening, and core strengthening/trunk stabilization programs.

Racquet Sports and Spine Injuries

Biomechanics/Pathogenesis: Significant neuromuscular coordination between lower and upper extremities and spine is a requirement in racquet sports. The serve involves potential susceptibility to injury of the vertebral column by hyperextension and rotation to initiate the serve and generate force along with the resultant lumbar flexion and rotation to decelerate the serve. The backhand and forehand involve coordination of the hips, forearms, shoulders, trunk and feet in a special way to achieve proper contact with the ball. Topspin and backspin are used to increase/decrease the ball's velocity and increase/decrease the ball's height/distance after it strikes the ground.

Common Disorders: Disorders include myofascial sprain/strain, delayed-onset muscle pain, cervical/thoracic/lumbar disc herniations, radiculopathy or somatic pain referrals, piriformis and sacroiliac/facet joint pain syndromes, spine and sacral stress fractures, osteoarthritis, ligament/tendon injuries, spondylolysis or pars stress fractures.

Clinical Exam: Perform a neurological/musculoskeletal directed-exam with provocative maneuvers and pain centralization through postural changes to evaluate the proper diagnosis. Evaluation of upper/lower extremity flexibility and trunk motion, muscle balance, ligamentous stability are needed to increase the overall predictive value of the evaluation process. Evaluation of footwear and orthotic insert is needed to determine biomechanics. Diagnostic and radiological evaluation should also be selectively evaluated including, possibly, x-rays, ultrasound, bone scans, CT or MRI scans, bone density scans, single-photon emission computed tomography (SPECT), or electrodiagnostics (EMG/NCS).

Treatment and Rehabilitation: Both acute and chronic injuries should involve activity modification with cessation or reduction of racquet/running activities, therapeutic (cold/heat/electrical stimulation) modalities, soft tissue mobilization, initiation of nonsteroidal anti-inflammatory or steroidal/pain medications, and following the RICE principle (rest, ice, compression, elevation). Subacute/chronic injuries should further be treated with directed stretching/flexibility/strengthening program; and occasionally a specialized physical therapy with advancement to sports-specific training programs. Interventional treatments, including fluoroscopic-guided spinal/pelvic injections following established guidelines, are well-documented in the literature and should be utilized as necesary. Non-impact loading aerobic exercises and aquajogging and substitutional aerobic activities (elliptical cross-trainers or bicycling) are useful during rehabilitation. Proper footwear evaluation should be performed by a trained professional as foot orthotic prescriptions may be necessary for select patients.

Training and Prevention: Strategies include: limitations in total racquet time by the athlete, aerobic cross-training, obtaining well-fitting footwear and foot orthotics, playing surface changes, spine/lower extremity/pelvic flexibility training, lower extremity/pelvic strengthening, and core strengthening/trunk stabilization programs.

Bicycling and Spine Injuries

Biomechanics/Pathogenesis: The pedal cycle (complete circular phase) is broken down into the power phase (top dead center to bottom dead center and the recovery phase (bottom dead center to top dead center). The power phase involves primarily hip flexors (initiation stage); quadriceps, other knee extensors, adductor magnus, gluteal muscles (early stage); hamstring, other hip extensors, and calf muscles (late stage); along with the paraspinal muscles recruited to stabilize the gluteal and hamstring muscles. The recovery phase involves the iliopsoas and hamstrings (initial stage); dorsiflexors and gluteal muscles (early-mid phase); and plantar flexors and knee and hip extensors (late stage). Proper bike fitting includes adjustments to the for- and aft-position, handlebar position, seat height, saddle type and saddle angle, and frame size. Efficient, well-trained cyclists aim for between 60-120 pedal revolutions per minute, thus placing each extremity under the power phase cycle between 3600-7200 times per hour.

Common Disorders: Disorders include myofascial sprain/strain, delayed-onset muscle pain, improper bike fit, cervical/thoracic/lumbar disc herniations, radiculopathy or somatic pain referrals, piriformis and sacroiliac/facet joint pain syndromes, spine and sacral stress fractures, osteoarthritis, ligament/tendon injuries, and spondylolysis or pars stress fractures.

Clinical Exam: Perform a neurological/musculoskeletal directed-exam with pro-vocative maneuvers and pain centralization through postural changes to evaluate the proper diagnosis. Evaluation of upper/lower extremity flexibility and trunk motion, muscle balance, ligamentous stability are needed to increase the overall predictive value of the evaluation process. Footwear and orthotic insert evaluation is needed to determine proper biomechanics should be inspected. Diagnostic and radiological evaluation should be selectively evaluated including, possibly, x-rays, ultrasound, bone scans, CT or MRI scans, bone density scans, single-photon emission computed tomography (SPECT), or electrodiagnostics (EMG/NCS).

Treatment and Rehabilitation: Acute through chronic injuries should include activity modification with cessation or reduction of bicycling activities, therapeutic (cold/heat/electrical stimulation) modalities, soft tissue mobilization, initiation of nonsteroidal anti-inflammatory or steroidal/pain medications, following the RICE principle (rest, ice, compression, elevation). Subacute/chronic injuries should further be treated with directed stretching/flexibility/strengthening program; and occasionally a specialized physical therapy and advancement to sports-specific training programs. Use of cardiac/bike monitors to improve cadence and aerobic efficiency. Interventional treatments including fluoroscopic-guided spinal/pelvic injections following established guidelines are well-documented in the literature. Non-impact loading aerobic exercises and aquajogging and substitutional aerobic activities (elliptical cross-trainers or running/jogging) are useful during rehabilitation. Periodization regimens are used to vary training variables to allow for rest and regeneration to improve overall performance. Foot orthotic prescriptions are necessary for select patients. Proper bike-fitting evaluation by a trained professional.

Training and Prevention: Strategies include limitations in total racquet time by the athlete, aerobic cross-training, obtaining well-fitting footwear and foot orthotics, playing surface changes, spine/lower extremity/pelvic flexibility training, lower extremity/pelvic strengthening, and core strengthening/trunk stabilization programs.

Clinical Exam: Perform a neurological/musculoskeletal directed-exam with provocative maneuvers and pain centralization through postural changes to evaluate the proper diagnosis. Evaluation of upper/lower extremity flexibility and trunk motion, muscle balance, ligamentous stability are needed to increase the overall predictive value of the evaluation process. Footwear and orthotic insert evaluation is needed to determine biomechanics should be inspected. Diagnostic and radiological testing should be selectively evaluated including, possibly, x-rays, ultrasound, bone scans, CT or MRI scans, bone density scans, single-photon emission computed tomography (SPECT), or electrodiagnostics (EMG/NCS).

Treatment and Rehabilitation: Acute through chronic injuries should include activity modification with cessation or reduction of full contact activities, therapeutic (cold/heat/electrical stimulation) modalities, soft tissue mobilization, initiation of nonsteroidal anti-inflammatory or steroidal/pain medications, following the RICE principle (rest, ice, compression, elevation). Subacute/chronic injuries should further be treated with directed stretching/flexibility/strengthening program; and occasionally a specialized physical therapy and advancement to sports-specific training programs. Cardiac monitors may be used to improve aerobic efficiency. Interventional treatments, including fluoroscopic-guided spinal/pelvic injections following established guidelines, are well-documented in the literature and may be utilized, as required. Non-impact loading aerobic exercises and aquajogging and substitutional aerobic activities (elliptical cross-trainers or running/jogging/cycling) are useful during rehabilitation. Periodization regimens are used to vary training variables to allow for rest and regeneration to improve overall performance. Foot orthotic prescriptions may be necessary for select patients along with proper equipment evaluation by a trained professional.

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Football and Spine Injuries

Biomechanics/Pathogenesis: Football can place significant compressive, shear, torsion, and rotational forces on the lumbar motion segments, leading to injury. Football players, especially lineman, are involved in activities that involve repeated forceful hyperextension of the spine, which delivers significant forces to the pars interarticularis, which may affect spondylolysis or spondylolisthesis.

Common Disorders: disorders include myofascial sprain/strain, delayed-onset muscle pain, contusions, cervical/thoracic/lumbar disc herniations, radiculopathy or somatic pain referrals, piriformis and sacroiliac/facet joint pain syndromes, spine and sacral stress fractures, osteoarthritis, ligament/tendon injuries, and spondylolysis/spondylolisthesis or pars stress fractures.

Training and Prevention: Strategies include limitations in full contact time by the athlete, aerobic cross-training, obtaining well-fitting footwear and foot orthotics, playing surface changes, spine/lower extremity/pelvic flexibility training, lower extremity/pelvic strengthening, and core strengthening/trunk stabilization programs.

Basketball and Spine Injuries

Biomechanics/Pathogenesis: Basketball can place significant compressive, shear, torsion, and rotational forces on the lumbar motion segments, leading to injury. Most spine injuries are lumber-related, and involve repetitive hyperextension, which delivers significant forces to the pars interarticularis and may affect spondylolysis or spondylolisthesis. Less involved in these injuries are overloading due to contact with another player, followed by hyperflexion activities.

Common Disorders: Disorders include myofascial sprain/strain, delayed-onset muscle pain, contusions, cervical/thoracic/lumbar disc herniations, radiculopathy or somatic pain referrals, piriformis and sacroiliac/facet joint pain syndromes, spine and sacral stress fractures, osteoarthritis, ligament/tendon injuries, and spondylolysis/spondylolisthesis or pars stress fractures.

Clinical Exam: Perform a neurological/musculoskeletal directed-exam with provocative maneuvers and pain centralization through postural changes to evaluate the proper diagnosis. Evaluation of upper/lower extremity flexibility and trunk motion, muscle balance, ligamentous stability are needed to increase the overall predictive value of the evaluation process. Footwear and orthotic insert inspection and evaluation is needed to determine biomechanics. Diagnostic and radiological testing should be selectively evaluated including, possibly, x-rays, ultrasound, bone scans, CT or MRI scans, bone density scans, single-photon emission computed tomography (SPECT), or electrodiagnostics (EMG/NCS).

Treatment and Rehabilitation: Acute through chronic injuries should include activity modification with cessation or reduction of basketball contact activities, therapeutic (cold/heat/electrical stimulation) modalities, soft tissue mobilization, initiation of nonsteroidal anti-inflammatory or steroidal/pain medications, and following the RICE principle (rest, ice, compression, elevation). Subacute/chronic injuries should further be treated with directed stretching/flexibility/strengthening program and, occasionally, a specialized physical therapy and advancement to sports-specific training programs. Cardiac monitors may be used to improve aerobic efficiency. Interventional treatments, including fluoroscopic-guided spinal/pelvic injections following established guidelines, are well-documented in the literature and may be utilized, as required. Non-impact loading aerobic exercises and aquajogging and substitutional aerobic activities (e.g. elliptical cross-trainers or running/jogging/cycling) are useful during rehabilitation. Periodization regimens may be used to vary training variables to allow for rest and regeneration to improve overall performance. Proper footwear evaluation should be performed by a trained professional as foot orthotic prescriptions may be necessary for select patients.

Training and Prevention: Strategies include limitations in total contact basketball time by the athlete, aerobic cross-training, obtaining well-fitting footwear and foot orthotics, playing surface changes, spine/lower extremity/pelvic flexibility training, lower extremity/pelvic strengthening, and core strengthening/trunk stabilization programs.

Gymnastics and Spine Injuries

Biomechanics/Pathogenesis: Demands on the musculoskeletal system respond to large amounts of force transmission in short, often repetitive, bursts, with an accurate, controlled response. Gymnasts develop skills to perform a variety of movements, including balance, agility, flexibility, strength, and coordination. Gymnast's skills have been classified into five categories: takeoff and push off from solid or elastic surface, rotations in vertical plane about a fixed or flexible horizontal axis of rotation, rotations in a vertical plane about a vertical axis of rotation, airborne rotations, and landings.

Common Disorders: Disorders include myofascial sprain/strain, delayed-onset muscle pain, contusions, cervical/thoracic/lumbar disc herniations, radiculopathy or somatic pain referrals, piriformis and sacroiliac/facet joint pain syndromes, spine and sacral stress fractures, osteoarthritis, ligament/tendon injuries, and spondylolysis/spondylolisthesis or pars stress fractures.

Clinical Exam: Perform a neurological/musculoskeletal directed-exam with provocative maneuvers and pain centralization through postural changes to evaluate the proper diagnosis. Evaluation of upper/lower extremity flexibility and trunk motion, muscle balance, ligamentous stability are needed to increase the overall predictive value of the evaluation process. A review of videotape or coaching evaluation may be useful in determining biomechanics. Diagnostic and radiological evaluation should be selectively evaluated including, possibly, x-rays, ultrasound, bone scans, CT or MRI scans, bone density scans, single-photon emission computed tomography (SPECT), or electrodiagnostics (EMG/NCS).

Treatment and Rehabilitation: Acute through chronic injuries should involve activity modification with cessation or reduction of gym/equipment activities, therapeutic (cold/heat/electrical stimulation) modalities, soft tissue mobilization, initiation of nonsteroidal anti-inflammatory or steroidal/pain medications, and following the RICE principle (rest, ice, compression, elevation). Subacute/chronic injuries should further be treated with directed stretching/flexibility/strengthening program and, occasionally, specialized physical therapy and advancement to sports-specific training programs. Cardiac monitors may be used to improve aerobic efficiency. Interventional treatments, including fluoroscopic-guided spinal/pelvic injections following established guidelines, are well-documented in the literature may be utilized, as required. Non-impact loading aerobic exercises and aquajogging and substitutional aerobic activities (elliptical cross-trainers or running/jogging) are useful during rehabilitation. Periodization regimens may be used to vary training variables to allow for rest and regeneration in order to improve overall performance.

Training and Prevention: Strategies include limitations in total gym/equipment time by the athlete, aerobic cross-training, obtaining well-fitting equipment needs, playing surface changes, spine/lower extremity/pelvic flexibility training, lower extremity/pelvic strengthening, and core strengthening/trunk stabilization programs.

Athletes with Physical Disabilities and Spine Injuries

Biomechanics/Pathogenesis: In sports for people with physical disabilities, classification is determined by lesion level, muscular strength, flexibility, balance, coordination, spasticity, sensation, and visual acuity. The fundamental philosophy of classification is to allow athletes with similar functional abilities to compete such that the competition is deemed fair.

Common Disorders: Disorders include myofascial sprain/strain, delayed-onset muscle pain, contusions, cervical/thoracic/lumbar disc herniations, radiculopathy or somatic pain referrals, piriformis and sacroiliac/facet joint pain syndromes, spine and sacral stress fractures, osteoarthritis, ligament/tendon injuries, and spondylolysis or pars stress fractures.

Clinical Exam: Perform a neurological/musculoskeletal directed-exam with provocative maneuvers and pain centralization through postural changes to evaluate the proper diagnosis. Evaluation of upper/lower extremity flexibility and trunk motion, muscle balance, ligamentous stability are needed to increase the overall predictive value of the evaluation process. An evaluation of equipment and orthotics should be performed to determine biomechanics. Diagnostic and radiological testing should be selectively evaluated including, possibly, x-rays, ultrasound, bone scans, CT or MRI scans, bone density scans, single-photon emission computed tomography (SPECT), or electrodiagnostics (EMG/NCS).

Treatment and Rehabilitation: Acute through chronic injuries should include activity modification with cessation or reduction of contact or non-contact activities, therapeutic (cold/heat/electrical stimulation) modalities, soft tissue mobilization, initiation of nonsteroidal anti-inflammatory or steroidal/pain medications, and following the RICE principle (rest, ice, compression, elevation). Subacute/chronic injuries should further be treated with directed stretching/flexibility/strengthening program; and occasionally a specialized physical therapy and advancement to sports-specific training programs. Cardiac monitors may be used to improve aerobic efficiency. Interventional treatments, including fluoroscopic-guided spinal/pelvic injections following established guidelines, are well-documented in the literature and should be used, as required. Non-impact loading aerobic exercises and aquajogging and substitutional aerobic activities (upper extremity trainers or elliptical cross-trainers or running/jogging) are useful during rehabilitation. Periodization regimens are used to vary training variables to allow for rest and regeneration in order to improve overall performance. Upper or lower extremity orthotic prescriptions are necessary for select patients. Evaluation of proper wheelchair or assistive device should be performed by a trained professional.

Training and Prevention: Strategies include limitations in total training/competition time by the athlete, aerobic cross-training, obtaining well-fitting upper/lower extremity orthotics and equipment needs, playing surface changes, spine/lower extremity/pelvic flexibility training, lower extremity/pelvic strengthening, and core strengthening/trunk stabilization programs.

Conclusion and Summary

The unprecedented level in popularity over the last few decades in increased participation in athletic sporting events has led directly to the increase in chronic/subacute spinal sports injuries. Sports provide many benefits including improvement in health status and physical fitness, relaxation, entertainment, and, for a select few, some prestige and a good source of income. Indirectly, the burgeoning population of elite athletes and "weekend warriors" will result in exponential increases in the number of sports spinal overuse injuries. Injury occurs when cumulative forces exceed the tissue's ability to withstand such forces—either due to isolated macrotraumatic events or repetitive microtraumatic events. Often, specific biomechanical or physiological factors predispose an athlete to injury. It remains in the medical/health personnel's domain to properly identify and assist the athlete to correct these conditions in order to treat, prevent, and possibly reverse the detrimental effects of chronic/subacute spinal sports injuries. As always, prevention is the best treatment but should be addressed alongside proper and successful rehabilitation.

In general, it appears that there is an eventual cost to the spine attributable to engagement in sporting activities. Proper training, nutrition, and equipment needs are likely to reduce this cost. Nevertheless, the benefits to general health and well-being may well outweigh the consequences of traumatic, degenerative, or metabolic effects considered among the effects of vigorous physical exercise.[1-4] ■

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