Adolescent athletes with low back pain or dysfunction are the most difficult patients for sports-medicine clinicians to treat. General orthopedic surgeons have little training in spine care; those with sports-medicine fellowships have dedicated training in the extremities, especially the shoulder and knee, with less emphasis placed on the spine. An orthopedic spine surgeon with fellowship training would be an asset for any sports team. Many are not involved in sports medicine but can provide excellent care as consultants if they are available.

The spine is clearly the area that athletic trainers, family practitioners, and other physicians specializing in sports medicine are the most uncomfortable with. Even though physical therapists and physiatrists are the most comfortable when treating lower back dysfunction in athletes, many still are not prepared to evaluate and treat the spine in a timely manner, allowing athletes the best chance to return as quickly and safely as possible to their sport.

Athletes most at risk for developing symptoms in the low back include those participating in football, hockey, soccer, golf, rowing, gymnastics, swimming, tennis, bowling, volleyball, basketball, and track and field.

Adolescents With Low Back Pain

A significant increase in the occurrence of low back pain occurs at age 12 and older. Several studies have found that in all age groups above 11 years, more than 50% have experienced lower back pain at some time in their lives—58.1% of females and 43.2% of males.\(^1,2\)

In adolescents who watched television 1–2 hr/day, 59.3% had low back pain; of those watching television more than 2 hr/day, 68.8% had low back pain.\(^1,2\) Other possible risk factors for developing lower back pain include increased height, decreased lumbar extension and straight-leg raising, increased lumbar flexion, and decreased muscle endurance of the abdominal and back muscles.\(^3-5\)

Specific muscle imbalances such as hip-flexor tightness have also been found to be associated with lower back pain.

After reviewing 100 athletes and 38 nonathletes, Kujala et al.\(^1\) found that the prevalence of low back pain correlated with hip-flexor tightness. Olsen et al.\(^2\) evaluated 1,242 individuals, of whom one third had restricted activities because of low back pain and 7.3% sought medical attention for it. In a study of 1,503 schoolchildren, age 14 years, Salminen and colleagues\(^3\) found that low back pain was the third most common form of pain interfering with schoolwork and sports. In this study, 65% were better in 1 month, but 35% reported disability from...
chronic low back pain, with recurrent or continued episodes of pain. There was a direct relationship between history of lower back pain and decreased straight-leg raise in adolescent males in a study by Miereau et al. on 402 children 10–18 years old. Ohlen et al. found that female gymnasts with low back pain had a significantly larger lumbar lordosis (41°) than did those with no low back pain history, who had a 35° lumbar lordotic curve. There was positive correlation between low back pain, age, female sex, time spent watching television, smoking, and competitive sports when Balague et al. evaluated 1,715 schoolchildren of both sexes.

We know that low back pain affects 80% of the population, and its prevalence in children is somewhere between 7% and 51%, depending on the study. Back pain in children is a major public health issue. The prognosis is that 90% are better in a few weeks to months, but 25% are still disabled at 1-year follow-up. 

We have developed a comprehensive history form that patients fill out before being evaluated, which helps to ensure that we obtain the entire medical history. This form can then be reviewed with the athlete and any family members present and allows more time for the evaluation. To fully evaluate an adolescent athlete with lower back pain or dysfunction, a history of previous injuries to the spine and other parts of the functional kinetic chain, especially the lower extremity joints, is absolutely essential. Oftentimes these previous injuries have not been fully evaluated or treated. An area that is not questioned enough is how much time has been spent by the athlete on seated weight machines, which can increase disk pressure. This, along with poor spinal mechanics for lifting, is one of the more common precipitating factors in increasing the risk of adolescent athletes developing lower back pain or dysfunction.

Evaluation

A complete and comprehensive medical history, including a detailed musculoskeletal history, is essential in establishing the differential diagnoses. Some of the more important points that should be included in the history are discussed here and outlined in the sidebar.

**History**

1. How the injury occurred or how symptoms began.
2. Previous injury to the spine, hip, knee, foot, and ankle and whether those were fully evaluated and treated (the kinetic chain).
3. The years and positions played in that sport and level of competition.
4. Other sports played, if any.
5. Previous treatment for current condition.
6. Diagnostic studies to date.
7. Ability to play in games and practices since the injury (essential).
8. Training errors.
   a. Using poor spinal mechanics for lifting.
   b. Seated weight machines often isolate individual muscles at the risk of the spine (sitting position increases disk pressure).

Physical Examination

The traditional physical examination of the spine is inadequate, and the following points should help in forming a complete and accurate diagnosis. At a minimum, there should be a functional screening exam of the lower extremities and spine, looking at the “big picture” first. This can be accomplished by using the six basic functional tests outlined in the sidebar on the next page. These tests should identify functional biomechanical deficits in the kinetic chain of the lower extremity and spine, as well as the pelvis and shoulder girdle. As an example, an adolescent right-handed golfer with lower back pain who has restricted subtalar-joint motion in the left foot might not be able to pronate (load) the whole left lower extremity. This, in turn, reduces knee internal rotation and hip external rotation, thereby causing excessive lumbar rotation to the right on the backswing. This makes up for restrictions in the hip range of motion in the transverse plane originally caused by decreased subtalar-joint pronation.

A cervical- and thoracic-spine screen and sacroiliac-joint motion tests should also be performed. Observation of a shift in the lumbar spine that is worse with extension or flexion is important, because shifts that are worse with extension generally have a poor prognosis and might take months to improve, rather than several weeks when the shift is worse with flexion and better with extension. A flexible shift might be present, in which the athlete is observed to have a shift to the left; simply touching the left shoulder will cause...
a translation to the right and vice versa. This type of shift has the worst prognosis, and even with surgical intervention it might not improve. The extremities, especially the lower extremities, are always screened in loaded and unloaded positions, along with manual muscle testing and a neurologic exam. Testing for adverse neurodynamic tension with the slump-seated straight-leg raise, supine straight-leg raise, and either the side-lying slump femoral-nerve stretch test or the prone femoral-nerve stretch test can be done with sensitizing and relieving maneuvers to help determine whether symptoms derive from muscle or adverse tension within the nervous system.

The best example of this is an athlete who presents with pain in the posterior thigh thought to result from a hamstring injury who, on slump-seated straight-leg raise with dorsiflexion, has an increase in the posterior thigh symptoms. If this athlete then, with neck extension, has complete resolution or at least a decrease in symptoms, this would lead us to suspect adverse neurodynamic tension from a disk herniation rather than simply a hamstring injury. Preferential end-range testing in flexion and extension, side bending, and rotation is somewhat helpful in finding a plane of motion that is the most successful and least successful; which aids in deciding which plane of motion the initial phases of rehabilitation should start with. Repeated motion testing in a somewhat unloaded prone position while propping up into extension on two fists, elbows, or a full press-up can help in determining whether pain centralizes or peripheralizes down into one or both lower extremities. A palpation exam by a skilled manual practitioner will involve a segmental exam looking for somatic dysfunctions, which include asymmetry and range of motion, and tissue-texture abnormalities. In addition, spring testing is recommended from T1–T2 through S1 levels over the spinous processes, asking the patient to report any pain and observing for spasm or a twitch response, as well as decreased spring.

**Differential Diagnosis**

A thorough history and physical examination, including a functional screening exam using the six basic functional tests, should help identify functional biomechanical deficits that have contributed to the injury and might subsequently delay the healing process.12-16 The sidebar at right summarizes the differential diagnoses in adolescent athletes with low back pain and dysfunction. After the comprehensive history, physical examination, and functional screening exam have been performed, the clinician will often come to a conclusion of disk herniation, in contrast to conventional thought, which considers spondylolysis conditions including complete fracture, stress fracture, and pars stress reaction the most common diagnoses associated with low back pain in athletes. Although both disk herniation and spondylolysis include pain on extension, an athlete with disk herniation presents with a history of having more pain with sitting and on physical exam will have a positive slump test with seated straight-leg raise relieved with neck extension and/or positive supine straight-leg raise.

A relatively new diagnosis of juvenile discogenic disease (JDD) must be considered when there are limbus-type vertebral-body changes seen in the thoracolumbar region similar to Scheuermann’s disease, as well as multilevel thoracolumbar disk degeneration that would not be expected in this age group. In JDD, clinical experience confirms that patients with proper rehabilitation can return to their sport safely and without any significantly increased risk of permanent damage to the spine. Although it is less common, one should not miss osteoblastomas, because 40% of these types of tumors occur in the spine, of which more than 60% originate in the posterior elements. Although metastatic disease is rare in adolescent athletes, pri-
mary lymphoma or leukemias are more common and should not be missed in this age group. Diskitis and osteomyelitis are seen in adolescent athletes but are more common in children under the age of 10.

## Diagnostic Testing

The unfortunate practice of ordering diagnostic imaging tests (see the sidebar on the next page) before evaluating an adolescent athlete is something that we strongly discourage. Imaging studies such as plain radiographic examinations, CT, and nuclear-medicine studies can often be avoided by using information obtained by taking a comprehensive history and performing a physical examination and the functional screening tests. By avoiding these imaging tests we spare the athlete a considerable amount of radiation exposure, as well as the cost of the tests. A simple and easy-to-follow algorithm based on history and physical-examination findings can be used to guide the decision-making process (Figure 1). The cost saving is enormous, as exhibited by the average price in our area for a lumbar-spine X-ray of $52, limited bone scan with SPECT (single photon emission computed tomography) scan of $425, and lumbar-spine CT (computed tomography) of $275, which total $752, compared with a $450 cost for a lumbar MRI (magnetic-resonance imaging).
Current algorithms place too much emphasis on radiographic examinations such as plain-film X-ray, CT, and bone scans. These provide an athlete with a fair amount of radiation exposure and might miss a disk herniation or annular tear. Both of these conditions, in this young population, produce pain on extension, often mimicking spondylolysis and spondylolisthesis-type lesions.

The innovative algorithm presented here takes into consideration history and physical-exam findings in adolescent athletes who have pain while sitting with extension or flexion of the lumbosacral spine. This population presents with pain on extension approximately 60% of the time when disk herniation is present, whereas in adults, at least 60% would feel more pain bending forward with a disk herniation. The slump-seated straight-leg-raise test, in particular, helps differentiate signs of disk herniation from spondylitic-type lesions. Using this algorithm would allow an MRI to be introduced sooner, sparing the athlete the typical imaging trio of an X-ray to diagnosis a spondylolysis or spondylolisthesis, followed by a CT scan to stage the healing process, and concluding with a SPECT scan to age the condition.

**Nonsurgical Treatment Options**

**Acute Stage**

In the acute (inflammatory) phase the athlete’s pain will be worse with movement, and pain will guide the rehabilitation process. Modifying the RICE (Rest, Ice, Compression, and Elevation) principle to MICE, this can guide the interventions during the initial phase of rehabilitation:

- **M**—Movements that reduce or do not increase pain in the sagittal, frontal, or transverse planes.
- **I**—Ice.
- **C**—Core control. Make certain that range of motion is controlled by using stretching and strengthening activities together to provide muscle stability within the available range.
- **E**—Extension trial. Determine whether pain centralizes with this motion.

In this phase, epidural steroid injections, including transforaminal, caudal, and interlaminar, are considered if straight-leg raising is less than 45° in the supine position or, in the slump-seated position, the knee cannot be fully extended. In addition, these types of injections are helpful when therapy has plateaued or cannot be started because of intense pain. Epidural...
steroid injections are also helpful when there is limited lumbar-spine range of motion in all directions or a lumbar shift that worsens with extension or leg pain is worse than back pain.

Acetaminophen or nonsteroidal anti-inflammatory drugs (NSAIDs), in our opinion, have a limited useful period of approximately 2 weeks. Oral steroids for 5–10 days at most at 0.5–1 mg per kg of body weight, given in a single dose in the morning after eating, can also be used when injection is not feasible. We also recommend avoiding NSAIDs in the active rehabilitation phase, because they will inhibit the inflammatory response necessary for strength gains (Evans, personal communication, October 2004).

Modalities including electric stimulation, ultrasound, and other modalities may be used in the acute phase for a limited time but typically do not significantly change the functional outcome.

Subacute Stage

The Physical Therapy Basics: A 7-Phase Continuum, developed by M. Clark (written communication M. Clark, National Academy of Sports Medicine, April 2004), is included here as a guide to rehabilitating and retraining an athlete after injury. The seven phases include the following:

- Corrective exercise training includes manual-medicine techniques, stretching, and strengthening. We prefer that these be done together in the midrange during the acute and subacute phases. Exercises should be performed in a slow, eccentric manner to groove a pattern through the central nervous system, with emphasis on proper technique. Repetitions: 15–20, but can be up to 30–35, depending on the sport. When using manual-medicine techniques, 3–5 repetitions for muscle-energy technique or joint play are usually sufficient.

- Integrated strength training should include squat progression from two legs to one leg on a stable surface. This is done with body weight and gravity while maintaining a neutral spine and translating the buttock posteriorly. When 20 squats can be accomplished in 20 s, external resistance of approximately 5% body weight, consisting of half in a dumbbell in each hand, may be added. Repetitions: 12–20.

- Stabilization equivalent training involves “supersetting” a strength exercise with a proprioception-rich exercise to build strength and endurance. Doing exercises such as balance and reach, as well as lunges with 3-D upper extremity reaches, will accomplish this goal. Repetitions: 8–12. Superset with another 8–12 reps on an unstable surface.

- Muscle-development training involves building muscle hypertrophy with higher volumes, muscle strength, and endurance using lunges, step-downs, step-ups, and a squat progression. Repetitions: 6–12.

- Maximum strength training builds maximum strength with higher intensities, and, in this phase, a slow 6-s eccentric contraction followed by a 2-s concentric contraction can be most effective in building maximum strength in a shorter period of time. Repetitions: 1–5.

- Elastic equivalent training increases force production at faster speeds by supersetting strength with a power exercise, which could include rapid lunging with step-ups, step-downs, and overhead 3-D reaches. Repetitions: 1–5.

- Maximum power training builds maximum force using power exercises with lower repetitions and higher weights at increased speed. Repetitions: 1–5.

Chronic Stage

In this stage of rehabilitation, ischemia rather than inflammation is present, and pain will no longer guide the process. Thermotherapy including continuous heat wraps for 8 hr can be very effective in this stage in helping to restore blood flow. Cryotherapy for painful flare-ups is very useful. Controlled movements showing the patient that his or her pain does not significantly change can be helpful in a patient with kinesophobia (fear of movement).

Return to Play and Performance Enhancement

Returning a young athlete to competitive athletics after an injury to the lumbar spine can be a daunting task. Risk of reinjury and returning to athletics at a lower level of competitiveness are often concerns of the athlete, as well as the team physician, physical therapist, athletic trainer, and strength and conditioning coach. In order to achieve unrestricted, competitive return to performance, there are many factors to consider.

Performance training, in and of itself, is risky and is a balance—stressing an athlete enough so that desired physiological and performance goals are reached while at the same time not exposing the athlete to potentially
injurious stress. A comprehensive strength and conditioning program that is sport specific and individualized to the athlete’s goals and limitations is vital if full return to competition is expected. For optimal results, the performance program needs to be based on sound biomechanical principles, speed, and sport specificity. In addition, such a program should be based on the principles of functional training and biomechanics.

It is vital that a young athlete begin a strength and conditioning program after a sound therapeutic exercise program has restored basic function and corrected biomechanical abnormalities and muscle imbalances. Ideally, this stage has restored muscle strength and stability, as well as preparing the athlete physically and psychologically for the next step in the functional-exercise continuum.

An athlete’s complete return-to-play progression begins with corrective exercise during early rehabilitation. The strength and conditioning program should serve as an extension of earlier interventions. For example, in the early stages of rehabilitation, proper motor recruitment of basic human movements such as squatting, pulling, pushing, and twisting should have been addressed and mastered before progressing to more challenging and aggressive methods of training. It is imperative that the later stages of rehabilitation and functional progression incorporate resistance exercise using body weight as resistance in all three dimensions of human movement. The inability to efficiently control and balance body weight and not being able to adequately maintain proper biomechanics throughout dynamic movement are contraindications for the athlete to progress to more aggressive training.

Putting the Maximus Back in the Gluteus

The function of the gluteus maximus is of great importance for young athletes in both rehabilitation and prevention of lumbar-spine pathology. The hip musculature including the gluteus maximus plays a significant role in transferring forces from the lower extremity up toward the spine during sport. Dysfunctional gluteal recruitment or inhibition results in abnormal stresses being placed on structures distal to the hip and can manifest itself in further injury or insufficient rehabilitation.

It is important to address gluteus maximus insufficiency during rehabilitation and the subsequent strength and conditioning phase of recovery. Our philosophy is to address this issue in a functional and sport-specific manner. The often incorrectly performed squat exercise serves as the basis for gluteal reconditioning. We begin by incorporating biomechanically correct squat exercises, with gradually increasing loads and intensity. In addition to the squat, multiplanar lunges have also been shown to stimulate gluteal muscle activity.

A young athlete is trained to correctly perform the squat by developing neuromuscular control of the spine as a unit, with minimal amounts of segmental movement. McGill and colleagues have shown that the squat exercise performed correctly elicits a high amount of gluteal and cocontraction muscle activity with minimal stresses placed on the spine. In addition, correct squat technique will maintain a “neutral spine” position, minimize compressive intervertebral disk forces, and increase muscle activity. During the early phases of an athlete’s strength and conditioning program we discourage the traditional use of a weighted barbell over the shoulders when performing the squat, because this places greater compressive loads on the spine and adversely affects spinal biomechanics.

Have the athlete hold a dumbbell or medicine ball in various positions while performing the exercise in the neutral-spine position (Figures 2 and 3). This will

![Figure 2 Squat exercise (correct).](image)

![Figure 3 Squat exercise (incorrect).](image)
have a dual effect of minimizing compressive loading of the spine and enhancing abdominal core stability as a result of upper extremity and trunk cocontraction. In later phases of training we also have athletes perform squats as part of superset complexes, often with 3-D plyometric jump squats or other lower extremity plyometric training in an effort to enhance explosive power (Figure 4).  

**Core Stability, Core Strength, and Core Explosion**

Recently, core stability has become the buzzphrase in the strength and conditioning community. Although having conditioned and stable abdominal muscles is of vital importance for those suffering from lumbar dysfunction, during the later stages of an athlete’s exercise program it is also important to develop and maintain sport-specific abdominal stability, strength, and explosive power. The core musculature is vital in stabilizing the lumbar spine and transmitting forces from the lower extremity to the upper extremity and vice versa, so athletes with less than ideal core stability should not progress into the later phases of strength and conditioning. If allowed to do so, they risk developing and reinforcing abnormal neuromuscular motor patterns that could lead to reinjury.

For competitive athletes, there needs to be a distinction between core stability and core explosion. Most sporting activities require sufficient core stability to minimize injury risk. When it comes to enhancing athletic performance, however, exercises should be designed to mimic both the sport-specific movements and speed of movement. Many sports require a high amount of explosiveness in the transverse plane through the core and hips. Examples of this include swinging a bat, kicking a soccer ball, or throwing a football. Training should incorporate movements in the transverse plane of motion and be speed specific. Some examples of high-velocity abdominal training in the transverse plane include various free-weight (Figure 5) and medicine-ball drills. This contrasts with most of the traditional forms of abdominal core training that overemphasize movements in the sagittal and frontal planes at slow velocities. In addition, explosive abdominal core training also requires athletes to develop the ability to eccentrically decelerate through the torso.

**Muscle Endurance—The Stronger the Spine, the Healthier?**

It has been thought for years that to effectively reduce sport-related lumbar-spine injuries, one needs to incorporate exercise that will strengthen the muscles that control the lumbar spine. The protective effects of strong muscles for the lumbar spine have not been elucidated adequately, but endurance of the trunk-extensor muscles has been shown to be the best predictor of whether or not one will suffer an injury. The first phase of training focuses on establishing sound muscle endurance, not only of the muscles with direct influence on the lumbar spine but also of the entire muscular system. The kinetic-chain perspective dictates that not only muscle endurance of the trunk extensors, flexors, rotators, and stabilizers be addressed but also movement patterns that stimulate them simultaneously. During this phase in an athlete’s

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**Figure 4**  Plyometric jump squat.  

**Figure 5**  Transverse-plane abdominal woodchopper.
progression, basic multijoint movements are performed with moderate resistance and high volumes. It is during this stage that we incorporate the Olympic-style movements and their variations. This allows the athlete to gain confidence and learn the various movements that will become the foundation during the final recovery stages. Examples include the dumbbell clean and press, and dumbbell snatch (Figures 6 and 7).

**Strength Enhancement**

The next phase of our integrated training approach attempts to more aggressively improve muscle strength. Depending on the athlete’s sport, this phase can also enhance muscle hypertrophy and muscle mass. Once adequate muscle endurance and efficient neuromuscular control of all exercise movements are achieved, it is time to increase the intensity. During this stage, many of the same movements are used, with the largest change being increasing loads. In addition, as this phase progresses, the incorporation of superset complexes can begin.

The primary goal of this stage is to increase strength, but we also expect the athlete’s confidence to improve as he or she begins to tolerate greater amounts of work with less discomfort. Early in this stage, basic multijoint exercises are performed individually but at greater intensity and lower volume. As the athlete progresses, the use of superset complexes begins. An example of a superset complex that we use would be the squat combined with dumbbell power snatch or the dumbbell lunge-and-press combined with dumbbell high-pull (Figures 8 and 9).

**The Final Stage—Explosive Power**

The final stage of an athlete’s strength and conditioning program is designed to transfer gains in sport-specific muscle strength into explosive power. Our integrated approach uses the Olympic-style weight-lifting movements (clean and jerk, snatch) as its foundation. Because most sport activities occur at high velocity, the ultimate goal of performance training should
be the maximum development of 3-D explosive power. If the preceding phases have been effective, this will also allow the athlete to minimize the risk of injury, during both training and competition.

With emphasis on maximum explosive power and rate of force development, we still include the use of other less powerful, multijoint, functional movements such as multidirectional lunges, numerous variations of the squat, and pressing and pulling movements. To maximize power development a combination of high-intensity, low-volume strength movements is mixed with explosive Olympic-style movements or plyometric activities. Recently, this has been referred to as “contrast loading.” Duthie and colleagues have described how preceding explosive movements with lower velocity strength movements can acutely “excite” the nervous system and maximize explosive-power output. As a result it has been hypothesized to develop into adaptations in explosive power and helping the athlete permanently transfer muscle strength into explosive power.

**Surgical Indications**

For adolescent athletes with focal or broad-based disk herniations, the surgical indications include progressive neurologic deficits such as decreasing grades of strength on manual muscle testing of the lower extremity. True bowel or bladder incontinence is another surgical indication, but not urinary stress incontinence such as seen with coughing, sneezing, or lifting motions. A helpful guide is a postvoid residual of more than 100 cc. A third indication is failure to respond to at least 3 months of nonsurgical treatment. Surgery must offer a reasonable chance for return to sport. In this phase, it is truly the patient’s choice, and he or she might opt to have surgery at less than 3 months of rehabilitation if the sport season is in jeopardy and surgery will provide a chance to compete at the previous level of function and not miss the entire season.

At this point it is important to mention some of the misconceptions and personal opinions that athletes have regarding surgical intervention. It is not uncommon to hear that a patient is too young for surgical intervention. Athletes at 14–15 years of age have responded well to surgical treatment after failure to respond to a variety of nonsurgical interventions. Another misconception is that the disk herniation is large and therefore must be removed for recovery to occur. The size of the disk herniation does not matter, and, in fact, larger disk herniations have been shown to reduce in size, often more quickly than smaller focal disk protrusions. It is not the size of the herniation that determines surgical intervention but how that herniation has affected the patient by causing progressive neurologic deficits, bowel and bladder dysfunction with incontinence, or failure to respond to nonsurgical treatment.

**Summary**

An adolescent athlete with low back pain might present with pain on extension more frequently when focal disk herniation is present than with pars interarticularis defects. A careful history describing pain made worse with sitting and physical-exam findings of a positive slump test or supine straight-leg raise test will lead the clinician to include focal disk herniations at the top of the differential-diagnosis list. An MRI would be the imaging study of choice, sparing the young athlete two to three studies that would increase radiation exposure and miss focal disk herniations. The cost savings are significant, as well.

Keep in mind that the risk factors for low back pain exist not only in the playing environment but also in the training room, at home, and in the classroom from sitting for prolonged periods of time. Even 1–2 hr of sitting can be detrimental and increase the risk of an athlete developing lower back pain. Training errors, often associated with the use of seated weight machines, can increase disk pressure.

The overwhelming majority of adolescent athletes with lower back pain will improve and return to their sport in a timely fashion. When surgical intervention is considered, there are clear criteria that must be met before taking the athlete down this path. It is our belief that postoperative rehabilitation is as important as the surgery in returning the athlete to sport as quickly and as safely as possible and reducing the frequency and severity of recurrences.

**References**


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**Upcoming Themes**

**November**

Professional Work Satisfaction  
*Katie Walsh, EdD, ATC, East Carolina University*

**January 2006**

Organization & Administration  
*Gary L. Harrelson, EdD, ATC, DCH Regional Medical Center, Tuscaloosa, AL*

**March**

Scapulothoracic Function  
*Thomas W. Kaminski, PhD, ATC, University of Delaware*

**May**

Professional Advancement  
*Katie Walsh, EdD, ATC, East Carolina University*

**July**

Innovative Instructional Techniques  
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**September**

Evidence-Based Knee Evaluation & Rehabilitation  
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