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Rehabilitation of Football Players With Lumbar Spine Injury (Part 1 of 2)

Jeffrey A. Saal, MD

Physical Medicine Series
Editor: Ernest W. Johnson, MD

In brief: Rehabilitation of football players with low back pain caused by injury is a comprehensive process. Accurate diagnosis followed by early intervention is necessary. The rehabilitation plan can be divided into two phases: the pain-control phase, discussed in this article, and the training phase, to be discussed in part 2 in a coming issue. The pain-control phase may include a variety of passive modalities, flexion or extension exercises, lumbar mobilization, traction, and selective (precise localization with precise center) injections. The author stresses the importance of understanding the anatomy and biomechanics of the lumbar spine, referred pain and potential pain generators, the stages of the degenerative process, and lumbar spine injuries when planning a rehabilitation program.

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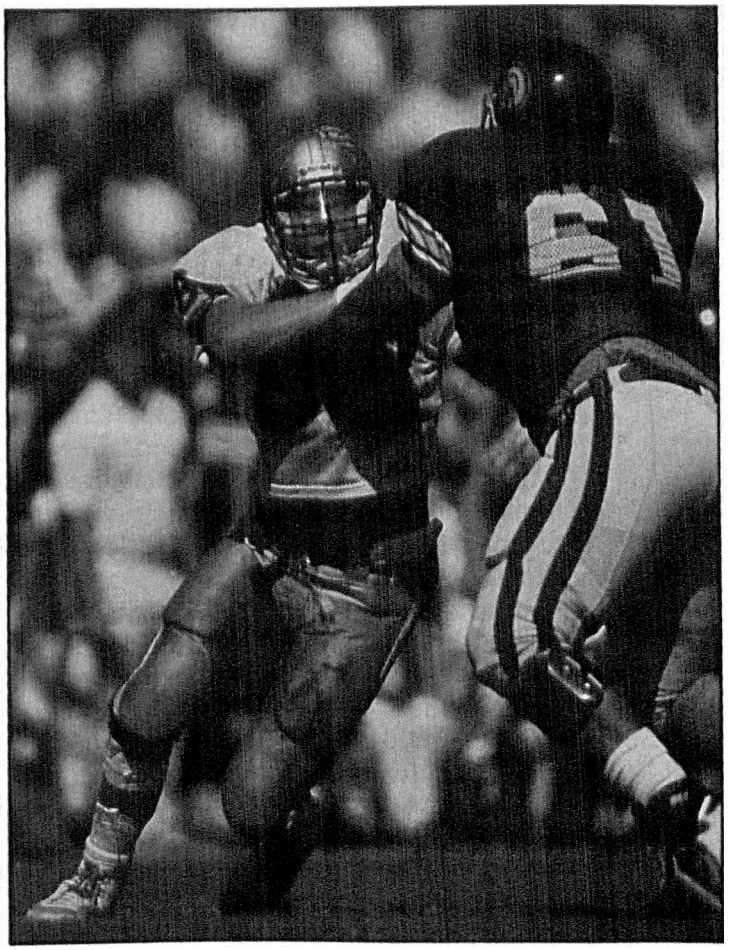

Football players—particularly interior linemen—are subjected to repetitive flexion, extension, and torsional stresses to the lumbar motion segments that predispose the lumbar spine to injury. When injury occurs, timely diagnosis, appropriate treatment, and a specific rehabilitation plan can enable the athlete to return to sports activity.

Rehabilitation of a football player with a lumbar spine injury presents a significant challenge to the sports medicine physician. Some of the activities involved in football—eg, repetitive flexion, extension, and torsional stresses to the lumbar motion segments—predispose the lumbar spine to injury. The likelihood of collision in football also places the spine in jeopardy. The most common sports and activities associated with lumbar spine injuries are gymnastics, weight lifting, football, dance, rowing, and wrestling.[1-5] It has been reported[6,7] that 30% of college football players will lose playing time because of a lumbar spine problem. A survey of injuries (1980 through 1986) in National Football League players reported a 12% incidence of spine injuries resulting in lost playing time.[8]

Repetitive extension and loading of the posterior elements of the lumbar spine have been associated with fatigue fracture of the neural arch (ie, spondylolysis).[3,9,10] The incidence of spondylolysis in gymnasts is reportedly as high as 22%.[2] An incidence of 21% was reported in a survey of 677 male high school and university athletes.[1] A study of college football players[7]

continued

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There is no scientific evidence that muscles are a primary cause of lumbar spine pain.

noted a 15% incidence of lumbar spondylolysis, which did not significantly increase during their college years. A higher incidence of spondylolysis has been found in interior linemen.[6] This finding probably is related to the repetitive loading of the posterior lumbar elements that occurs when the linemen rise from their low starting position to the blocking posture, while maintaining lumbar lordosis. Indeed, linemen may sustain many of their injuries in the weight room; weight training is a common cause of low back injuries in football players. I have observed that improper technique while attempting squats using free weights accounts for many of these injuries.

Diagnosing lumbar pain remains a difficult conundrum. Many names are given to lumbar pain syndromes in an attempt to describe what would most appropriately be designated "nonspecific lumbar pain with and without radicular referral,"[11] ie, with or without leg pain. The semantics reflect the background training, speciality, and bias of the examining physician. Some commonly used terms include lumbar sprain or strain, lumbago, myofascial pain, iliolumbar ligament syndrome, sacroiliac dysfunction, lumbar malalignment, and multifidus syndrome. There is no scientific evidence that muscles are a primary cause of lumbar spine pain. Referred pain (pain that is felt in an area other than its origin) in the muscles can arise from any source that sends its afferent signals to the dorsal ramus system.[12]

It is generally accepted that ligaments and fascia can be sources of primary pain, but there is no substantiation that they cause pain syndromes that persist longer than four to six weeks. The soft tissues of the lumbar region follow the same biological rules as other areas of the body. Hamstring muscle injuries do not create pain syndromes that persist beyond the normal point of healing. Acute athletic injuries of the lumbar spine may indeed involve soft-tissue structures, but rarely, in my experience, do they call for aggressive rehabilitation. Rather, they require nonspecific local treatment, as well as time, for complete resolution of symptoms. Patients with such injuries are among the 90% of patients whose symptoms associated with acute lumbar pain syndromes resolve in six weeks, regardless of the care administered.[13]

In this paper I discuss football players with lumbar pain resulting from an injury who do not respond to six weeks of nonspecific care, and who are then referred to a spine specialist. Patients who are referred to me are different from those who can be handled in the training room by nonspecialists. In my experience, 70% of football-related lumbar spine injuries involve the posterior elements. The intervertebral disk can be incriminated as the pain source in 25% of cases, although most of these cases are uncomplicated annular tears, and pain resolution occurs within two to six weeks. The remaining 5% encompass a melange of inflammatory spondyloarthropathies, neoplasm, sacroiliac joint syndromes, spinous and transverse process fractures, vertebral body-compression fractures, direct contusions, and viscerogenic and vascular syndromes masquerading as skeletal pain.

Diagnostic Principles

Although the major focus of this article is rehabilitation, a limited discussion about diagnosis may be helpful. Establishing a diagnosis is the first and most important task for a physician who is treating a football player with low back pain. Without an accurate and timely diagnosis, it is virtually impossible to plan a specific treatment and rehabilitation program that will enable the athlete to return to sports activity. Localizing the cause of pain is paramount in diagnosing spinal pain. Indeed, the structure that appears to be most involved, based on a computed tomography (CT) scan or other imaging study, may not be the structure that is generating the disabling pain. Therefore, careful correlation of the history, mechanism of injury, physical examination, and diagnostic studies is imperative in locating the pain generator(s). An understanding of referred pain and potential pain generators is therefore necessary for this undertaking.[12]

Studies from 1969[14] and 1970[15] note that repetitive torsional loads to the lumbar spine cause annular injury that leads to degenerative changes of the disk. A more recent study (1985)[16] notes that these same torsional stresses cause leakage of synovial fluid from the lumbar facet joints, which may lead to early advancement of facet arthropathy. The motion seg-

ments at risk for torsional injury lie above the intercristal line (usually the L4-5 interspace coupled with the L3-4 interspace). The L5-S1 motion segment is reportedly more susceptible to axial compression injury than the segments above that level.[14,15] In the skeletally immature athlete, the vertebral end-plate is at risk for intraosseous disk herniation. This is probably a direct consequence of an axial loading injury.[17] Formation of Schmorl's nodule is caused by intraosseous disk herniation into the vertebral end-plate.[18]

Because of the high incidence among athletes of injuries to the posterior elements of the lumbar spine, it is necessary to understand the biomechanics of this part of the spine. The lumbar facet joints are exposed to increased articular cartilage loading pressures in both extension and torsional maneuvers.[19,20] Repetitive extension maneuvers can cause facet synovitis, and may lead to facet arthropathy. A degenerative segment has decreased resistance to torsional stress.[21] Changes in foramen size have been demonstrated in a degenerative segment with posture movement.[22] It is important to appreciate this phenomenon in order to understand the potential cause of foraminal nerve-root injury in the presence of only a mildly narrowed neuroforamen. Facet tropism will lead to the transfer of asymmetric loads to the facet articular surfaces, as well as to the anulus.[23] Facet tropism may be a predisposing factor for the development of facet pain syndromes in athletes, but this needs to be elucidated in controlled studies.

The hallmark work of Yong-King and Kirkaldy-Willis,[24] which outlines the stages of the degenerative cascade, forms the foundation for understanding lumbar spine injuries. This degenerative process can be greatly accelerated in athletes, and can be encountered in athletes of all ages and competitive levels. Adjacent motion segments within the lumbar spine will often be at different stages along this cascade. Therefore, a thorough understanding of the pathomechanics of the entire lumbar spine is necessary when planning a rehabilitation program.

The athlete population spans all age ranges. Rehabilitation of the lumbar spine will therefore encompass degenerative processes as well as pure injury phenomena. The interplay of injury and the preexistent stage of degenerative change of the motion segment involved form the basis for understanding the anatomic structure that may be at risk. The presence of a degenerative segment in a college athlete is neither rare nor surprising, considering the loads that are placed on the spinal structures—not only during athletic training and competition, but in daily life as well.

The degenerative process can be encountered in athletes of all ages and competitive levels.

A final note on the diagnostic phase deserves mention. When used in isolation, diagnostic studies that examine only structural changes cannot establish the cause of persistent pain. This has been demonstrated repeatedly in studies attempting to correlate structural changes seen on lumbar x-rays, myelograms, and CT scans with a patient's complaints of pain. The best, most thorough diagnostician can sort through the clinical information derived from the patient's history, the mechanism of injury, a careful physical examination, electrophysiologic studies (eg, electromyography, somatosensory evoked potential), imaging studies, results of treatment, and the social factors surrounding the pain process to arrive at a diagnosis.

Rehabilitation programs can be divided into two phases: pain control and training. The pain-control phase may include a variety of passive modalities, flexion or extension exercises, lumbar mobilization, traction, and selective injections. After successfully completing the pain-control phase, the individual advances to the training phase, which emphasizes movement training and specific lumbar stabilization exercises. (The training phase will be discussed in part 2 of this article.)

Pain-Control Phase

Treatment during the pain-control phase should be instituted as early and efficiently as possible. Individuals should not get stuck in this phase, but should advance as rapidly as possible to the training phase.

Back First Aid. The initial aspect of the pain-control phase—back first aid—involves ice application,[25] resting in a comfortable position, and basic instruction in body mechanics to facilitate pain-free movement while getting in and out of chairs, cars, and bathtubs, and on and off of toilet seats. The athlete is taught to control pain and muscle spasm; thus the use of medications can be kept to a minimum. The type of

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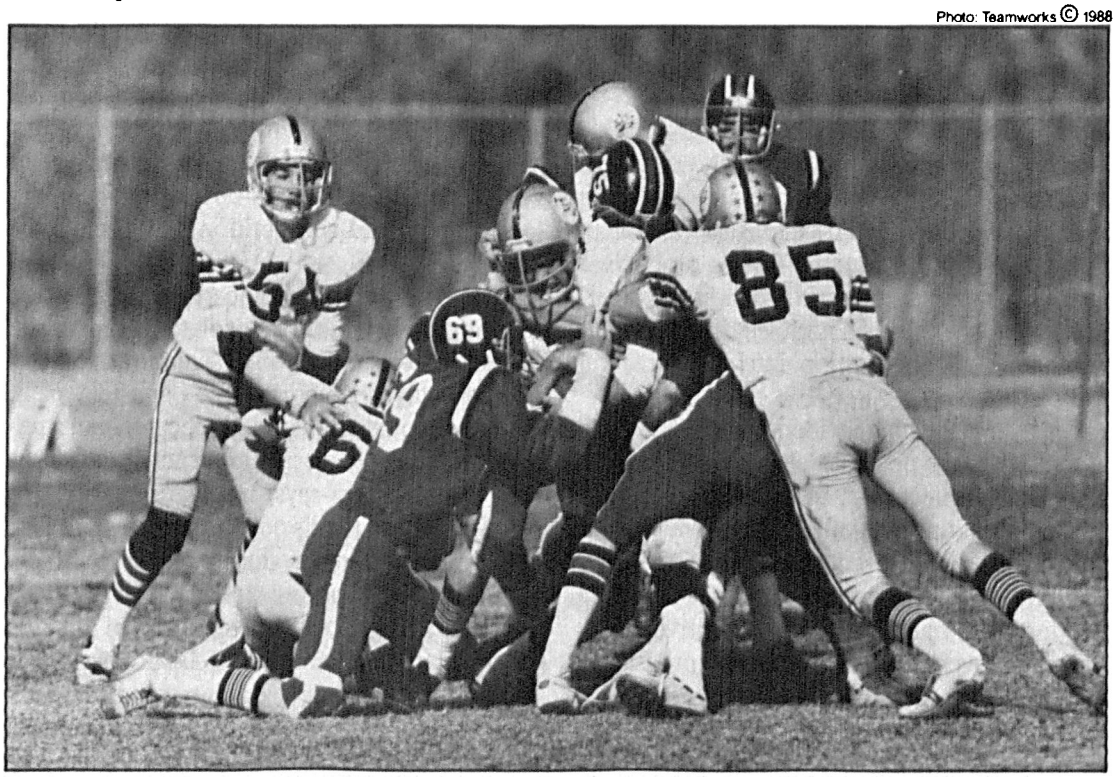

An estimated 30% of college football players will lose playing time because of a lumbar spine problem. However, they are not alone. Also at risk for lower back injury are athletes who participate in gymnastics, weight lifting, dance, rowing, and wrestling.

injury sustained—injury to the anterior structures (ie, the diskovertebral joints) vs the posterior structures (ie, the facet joints and neural arch) will determine the position of comfort for the individual.

Although rest is specifically prescribed during this initial phase, total bed rest is not. Bed rest—the most abused and overprescribed treatment modality in lumbar spine care—should be used only to control pain in the early days following the injury. There is no evidence to support total and absolute bed rest after any injury to the lumbar spine.[26] Indeed, excessive bed rest will lead to hypomobile lumbar motion segments, tightened soft tissues, loss of muscle strength, blunting of motivation, and loss of mineral matrix from bone.[27]

Extension Exercises. Pain-relieving modalities, such as transcutaneous nerve stimulation[28] or electrical muscle stimulation coupled with ice, can also reduce the acute pain.[29,30] Extension exercises are valuable for reducing pain from disk injuries.[31] The principle of extension exercises may very well be explained by a reduction in neural tension rather than by nuclear migration, as initially proposed.[32] When extension exercises cause centralization of low back pain, without exacerbating it or causing lower extremity pain (ie, radicular pain), they can be used.

Peripheralization of the pain contraindicates the use of extension exercises. Also, it may indicate stenosis, far lateral disk protrusion, or pathology of the posterior elements. A lumbar shift must be corrected before an individual begins extension exercises. If these exercises are attempted by a patient who has a lumbar list, the pain may become exacerbated, which could lead to an erroneous decision (on the part of the patient, the physician, and the physical therapist) to abandon the extension exercises.

No one should continue with one particular type of exercise regimen during the entire treatment program. Rather, each person should progress though the program and not be left with an extension-exercise regimen, for example, as the only exercise component. Overuse of extension exercises, even in the case of a pure disk injury, can lead to facet pain. Therefore, pa-

tients should avoid overexercising.

Flexion Exercises. Flexion exercises are the most useful for injuries to the posterior elements of the lumbar spine. Flexion has reportedly caused a reduction in articular weight-bearing stress to the facet joints.[32] Another benefit of flexion exercises is that they stretch the dorsolumbar fascia.[33]

Spine Immobilization. This is rarely necessary in sports-related spine injuries, except for cases of frank instability caused by fracture and disruption of both the posterior and anterior elements. There are proponents of immobilization for acute pars interarticularis stress fracture.[34] However, there is no compelling evidence that stress fractures heal to any greater degree with or without immobilization. Abstinence from sports activity, along with adequate pain-control therapy, alleviates the pain, and immobilization seems to make no additional difference in the healing process.

Neoprene lumbar corsets help maintain warmth and enhance flexibility for many athletes, but they are useless for controlling instability.

Mobilization. Mobilization techniques can be extraordinarily useful for attaining articular and soft-tissue range of motion.[35] Stiffened lumbar motion segments should be mobilized, and tight soft tissues must be adequately stretched. Ultrasound helps facilitate soft-tissue extensibility, which allows adequate articular and soft-tissue mobilization to occur.[36] Caution must be used with ultrasound if an acute radiculopathy is present. Possible posttreatment exacerbation of radicular symptoms may occur; this probably is related to neural swelling. The thoracolumbar junction segments, specifically, should be considered for mobilization. These segments often become hypomobile and can be pain generators themselves, often masquerading as a lumbar pain syndrome.[37] Mobilization should be carefully graded and timed in the treatment program; overvigorous mobilization can be harmful in all types of injuries.

Traction. Traction may be used to relieve symptoms in the treatment of disk injury subtypes (disk protrusion, herniation, and annular tears). There are proponents of various types of traction, including gravity inversion,[38,39] gravity lumbar reduction,[40] autotraction,[41] and pelvic traction.[42] Depending on the size of the patient, the type of equipment available, and the type of disk pathology present, any of these traction modalities may help relieve symptoms. Although many studies[38-41] cite subjective reports of relieved symptoms, I am aware of no scientific evidence to support the contention that any traction technique actually facilitates nuclear migration. Nor is there a direct correlation with disk contour changes before and after traction.[42]

Autotraction possesses some unique advantages in its ability to be polyaxial (traction can be applied in many axes) and patient controlled.[43]

Gravity inversion can be used at home on an ongoing basis, as long as hypertension or retinal problems do not develop. This traction method also is patient controlled.[44,45]

Bed traction can only serve to restrain the patient. A force equal to approximately 26% of body weight is required to overcome just the surface resistance of the lower half of the body.[46,47] Therefore, unless enormous amounts of weight are used, this resistance factor cannot be overcome, and vertebral separation cannot occur.

In a study that used a split table to reduce frictional forces, a weight equal to 50 lb of intermittent force for 16 minutes caused posterior interbody separation of the vertebra, although no residual separation was noted 39 minutes after traction.[48] Therefore, the mechanism by which traction relieves symptoms is unclear. Theoretically, pain relief may be mediated by a neurophysiologic mechanism that reduces the transmission of the pain message, rather than by direct mechanical forces upon the disk.

Selective Injections. One of the most powerful tools in the pain-control armamentarium is the use of selective injections. These include epidural cortisone injections from the translumbar or sacral approach, intra-articular facet injections, lumbar selective nerve-root blocks, trigger-point injections, and acupuncture.

The strong point of injection techniques is specificity. Therefore, precise diagnostic localization by means of an accurate history and physical examination, coupled with confirmation by appropriate imaging and/or electrophysiologic study, is imperative before proceeding.

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One of the most powerful tools in the pain-control armamentarium is the use of selective injections.

Numerous well-controlled studies demonstrate the usefulness of acupuncture as a pain-relieving modality.

A discussion of differential diagnosis is beyond the scope of this paper, but can be found elsewhere.[49]

An epidural cortisone injection for a patient with lumbar radiculopathy caused by disk injury or stenosis can provide dramatic relief of pain.[50,51] Epidural cortisone is most beneficial for patients with more leg pain than back pain, and who manifest signs of dural tension on physical examination. Early, aggressive use of epidural cortisone can greatly enhance the rehabilitation program.

Intra-articular lumbar facet injections under fluoroscopic guidance are useful for placing corticosteroids into inflamed facet capsules.[52] Injection directly into a spondylytic defect has also relieved pain, probably because the medication spreads from the defect onto an inflamed, exiting nerve root subjacent to the lytic defect.

Lumbar selective nerve-root blocks are useful for instilling medication around an inflamed nerve root that is principally entrapped, either within the foramen or by a large, lateral disk fragment that has migrated foraminally.[53] This technique also is useful in the case of an extraforaminal nerve that is entrapped by an enlarged transverse process at the L5-S1 level. Coupling epidural injection with selective nerve-root block is often necessary for patients with a large disk herniation with or without foraminal stenosis.

Trigger-point injections with local anesthesia can be useful only for reducing painful muscle spasm associated with persistent trigger zones identified in the offending muscles.[54] There is no physiologic basis for adding corticosteroids to this type of injection.[55] Attempts to explain these trigger points on the basis of an inflammatory focus (as defined by cellular infiltrates and chemical substrate activity), have not been satisfactory. Trigger-point injections, followed by soft-tissue stretching and mobilization programs, can dramatically improve range of motion and reduce pain. Soft-tissue pain is often the principle disabling pain factor, even when structural diskogenic pathology has been diagnosed.

It has been reported in Western literature[56] that every known trigger-point injection corresponds to a known acupuncture point. It has also been reported[55,57] that dry needling a trigger point (breaking the skin with a needle without injecting anything, as in acupuncture) is just as effective as injecting the trigger point with a local anesthetic solution alone, saline alone, or local anesthetic solution plus corticosteroid. Endorphin release following acupuncture has also been demonstrated.[30,58-60] Treatment with naloxone can block endorphin release and blunt acupuncture analgesia.[61] Numerous well-controlled studies demonstrate the usefulness of acupuncture as a pain-relieving modality.[62]

It must be kept in mind that acupuncture as well as the other injection procedures described here are purely facilitators of treatment and should be considered as adjunctive therapy only. They are useful in the pain-control phase and should be used to enhance rehabilitation rather than as treatment ends in themselves.

Nonsteroidal Anti-inflammatory Medication. Early in the treatment program, the use of anti-inflammatories may be appropriate. Because of their analgesic effect, and because they act as prostaglandin synthetase inhibitors, anti-inflammatory agents play a role in the treatment of lumbar pain syndromes.

Muscle Relaxants. Prescribing so-called muscle relaxants has no physiologic basis. All of the currently marketed muscle relaxants are, indeed, central nervous system depressants rather than peripherally acting muscle relaxants. I advise against their use for this reason, and because of their potentially addictive nature.[63]

Opiate Analgesics. It is occasionally necessary to use opiate analgesics during the initial week of treatment of lumbar pain syndromes. However, they should rarely be used after the patient has begun a specific rehabilitation program. At that point, the proper use of positioning, rest, ice, transcutaneous nerve stimulation, extension or flexion exercises, and selective injections will usually obviate the need for these agents.

Oral Corticosteroids. Oral corticosteroids can be useful in treating acute radiculopathy. Caution is advised regarding young athletes, specifically in relation to gastric distress, disorientation, potential activation of seizures, and flaring of acne vulgaris. This last complication may indeed be the most disturbing one to young

athletes. Anabolic-androgenic steroids and male hormone supplements have no place in the treatment of injured athletes.

After progressing as rapidly as possible through the pain-control phase, the patient can begin the training phase, which is the key component of the rehabilitation program.

The training phase of the rehabilitation program will be discussed in part 2 of this article. **PSM**

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AL-4052 AL-BPI-1/88

Reference

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*In controlled single-dose studies with Alupent Inhalation Aerosol, the duration of effect of two to three inhalations (20% or greater increase in FEV_1) has varied from one to five hours. In multiple-dose studies (up to q.i.d.), the duration of effect for a similar dose of Alupent has ranged from about one to two and a half hours.

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lumbar pain continued

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