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Active or Inactive Spondylolysis and/or Spondylolisthesis: What's the Real Cause of Back Pain?

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GRAND ROUNDS PRESENTATION

This 16-year-old male patient presented to a chiropractor with low back pain. He related that he hurt his back while playing baseball. His physical examination, including vital signs, was considered normal. His weight was 142 lbs. The patient complained of sharp lumbosacral pain, which was worsened with rotation and extension of the trunk. Extension, left lateral flexion, and left rotation were mildly restricted. He was neurologically intact. Routine orthopedic tests performed on his lower back were initiated. There was no significant pain except for Kemp's test in hyperextension.

He received 4 weeks of chiropractic care (eight sessions) that included chiropractic spinal manipulation, electrical muscle stimulation, ultrasound, and passive stretching. Very little relief was obtained from these treatments, and the chiropractor decided that x-rays were indicated.

Conventional radiographs demonstrated a left-sided pars defect and a questionable right-sided pars defect at L5 without slippage (Fig. 1). To visualize more adequately the pars interarticularis, a computed tomogram of the lumbar spine was performed (Fig. 2), which showed a complete defect on the left and a partial pars defect on the right at L5. In an attempt to determine whether these defects were clinically active, a single photon emission computed tomography (SPECT) bone scan was obtained (Fig. 3). The nuclear medicine scan showed marked activity in both pars at the L5 level, consistent with active spondylolysis that was the most likely cause of the patient's localized pain.

The patient was then referred to an orthotist who custom fit him with a Boston overlap (antilordotic) brace. While in this brace, the patient performed aquatic exercises three times per week for 8 weeks. After this 8-week period of time, the patient was asymptomatic. Follow-up computed tomography (CT) scan (Fig. 4) showed both the right and left pars defects at L5 to have completely healed with bony union. The patient was released to a home exercise program. Two years later, he was still asymptomatic and had returned to normal physical and sports-related activities.

GRAND ROUNDS DISCUSSION #1

This is a case of a 16-year-old male suffering from low back pain apparently due to repetitive twisting from baseball pitching. Extension and rotation movements aggravate the pain. He consulted a chiropractor and received manipulative procedures. These provided no relief and plain-film radiographs were obtained. They revealed probable spondylolysis without slippage at the L5 pars interarticularis. A CT scan confirmed that there were bilateral pars defects and a SPECT bone scan showed they were both hot (active). Manipulative therapy was discontinued. He was put in a Boston overlap (antilordotic) brace and completed an aquatic exercise rehabilitation program. After 8 weeks, he was asymptomatic and follow-up CT scan demonstrated that the pars defects had healed.

This case clearly represents an example of the theory that spondylolisthesis is due to a stress fracture at the pars interarticularis. There had been conjecture that spondylolysis was a congenital variant of normal due to failure of fusion. However, there has been no evidence to support this hypothesis, especially a lack of findings in newborns. Stress fracture is proposed as a mechanism for spondylolysis, resulting from recurrent mechanical stress in the upright posture (1–6). Age of onset is typically between 10 and 15 with a higher prevalence in athletes. Clinically, most are asymptomatic or discounted as "growing pains" resulting in failure to recognize their existence. Because they are not identified, immobilization and stabilization do not occur, resulting in improper healing. Whether anterior slippage of the vertebral body occurs likely depends on continued stress applied to the injured segment. As time passes, an individual with an undetected spondylolysis will likely suffer from repeated episodes of low back pain, typically described as dull and aching. With age, these episodes may be more frequent and intense, causing the individual to seek a professional opinion. It is usually at this time that an x-ray will demonstrate the presence of spondylolysis or spondylolisthesis.

Manual therapies in most forms, but specifically the high-velocity, low-amplitude thrust procedures common to chiropractic practice, are not indicated for the direct treatment of acute fractures. As is the case with this individual, manipulative therapy is not beneficial. However, most cases of spondylolysis or spondylolisthesis are not identified during their acute or active phase. Instead, after many years and continued stresses, slippage becomes more likely (7). This produces an anterior shift in weightbearing resulting in extra load on the facets and a potential shear

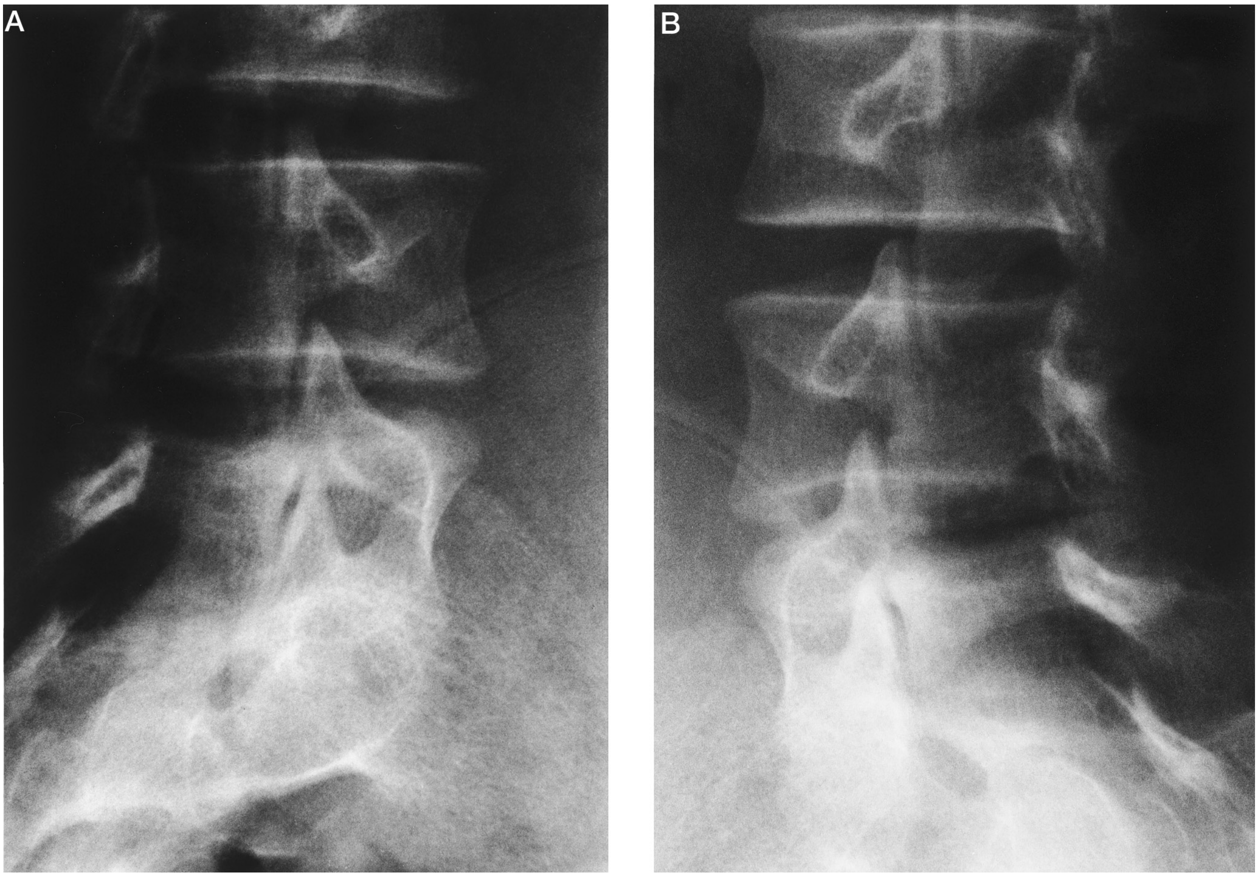

FIGURE 1. A and **B**, Conventional radiographs: lumbar obliques. Observe the bilateral pars defects at the L5 vertebra. *Comment:* This 16-year-old athlete complains of sharp lumbosacral pain. Are these lesions active or inactive? What tests will help us determine this?

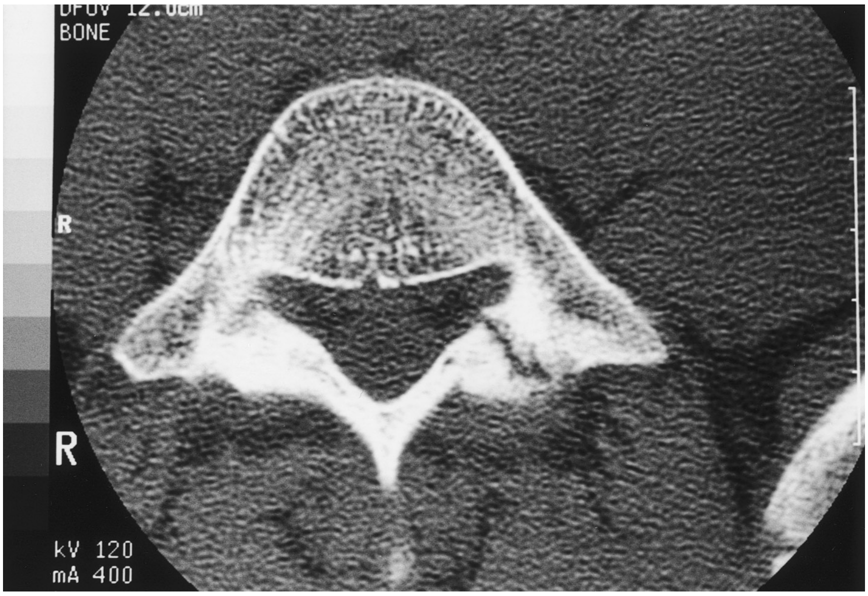

FIGURE 2. Computed tomography (CT): L5. There are bilateral pars defects at L5 with the left side being larger than the right. *Comment:* CT is a morphological imaging modality and does not tell us the age of the pars defect. No one can predict which pars defects seen on CT scans are symptomatic or asymptomatic; that clinical decision requires physiological imaging (SPECT or MRI scan).

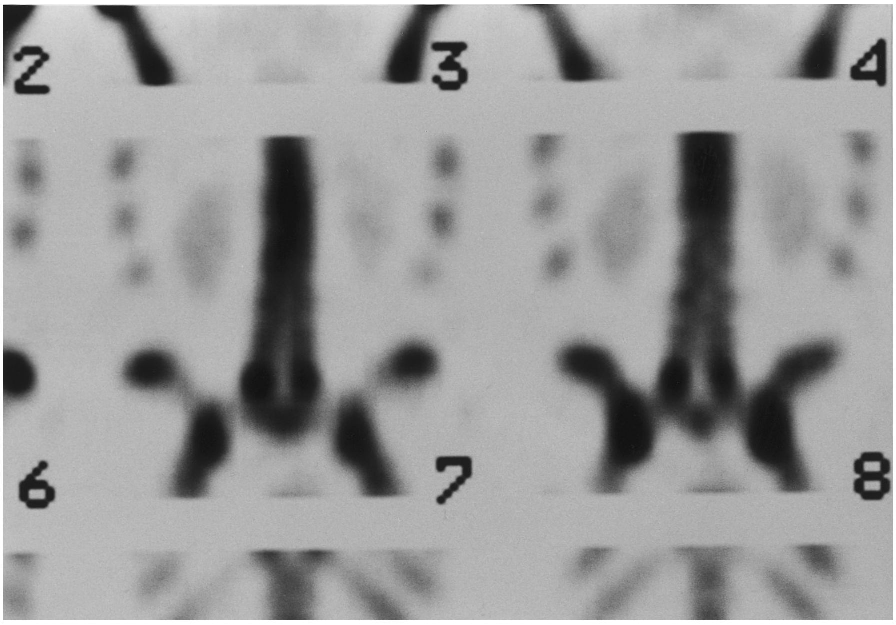

FIGURE 3. Single-photon emission computed tomography (SPECT) scan. There is intense bilateral uptake of the radionuclide at the L5 pars interarticularis. *Comment:* The positive uptake at the L5 pars indicates the ''active'' nature of these lesions. This athlete's back pain was caused by these pars defects.

FIGURE 4. Computed tomography: L5, 8 weeks later. This follow-up CT was performed 2 months after this 16-year-old athlete wore a Boston overlap (antilordotic) brace. The previously identified bilateral pars defects have now healed, verifying their previous ''active'' nature.

force to the intervertebral disc. The affected level may be the symptomatic segment though, in many cases, it will be the segments above or below that produce the signs of symptoms. Conservative care, including the use of spinal manipulative therapy, is indicated in these chronic recurrent cases involving spondylolysis and/or spondylolisthesis. Examination of these individuals will often reveal on postural examination the presence of prominent buttocks and lumbar hyperlordosis with a transverse skin furrow. The patient will describe a deep aching pain characteristic of sclerotogenous patterns. With L5 being the most common level, deep aching pain in the greater trochanter, ischial tuberosities, and lateral femur will often be reported and can be confused with sciatic pain. Furthermore, with the anterior shift in weightbearing, stress can be applied at the thoracolumbar junction. Irritation in this area can lead to pain projection into the buttocks, hip, and groin following the distribution of the cluneal nerves (Maigne's syndrome) (8). Moreover, a histologic study of the tissue in the pars defect revealed neural elements in the form of free nerve endings, suggesting that the pars defect itself may be a source of back pain (9).

Treatment of individuals with back pain due to a stress fracture of the pars interarticularis must be divided into two groups: acute (active) or chronic (inactive). The acute phase, identified with SPECT bone scan, can be managed conservatively using some form of bracing and rehabilitation focusing on stability (10,11). The chronic phase can be managed conservatively using many forms of manual therapy in concert with physical modalities, exercise, and lifestyle changes. The decision as to which form of manual therapy should be employed must be based on the patient's tolerance and response. Side posture, high-velocity, low-amplitude thrust technique applied to the low back, especially the levels above and below the level of the spondylolisthesis, can be used (12,13). Mierau et al. (14) studied 285 chronic back pain patients treated with side posture, high-velocity, low-amplitude chiropractic manipulation. They concluded that there was no significant difference in the treatment outcome between patients with or without spondylolisthesis. They further stated that "spondylolisthesis is not, then, a contraindication to skillful, specific, side posture manipulation to the dysfunctional joints above and below the spondylolisthesis. In the majority of cases, the radiographic findings of spondylolisthesis will have no effect on the outcome of spinal manipulative treatment." The use of intermittent lumber flexion distraction (Cox maneuver) has also been used with favorable response (15,16). A classic technique has been described in the supine position with the patient's knees drawn to his or her chest and the clinician applying pressure to the legs while pulling on the sacral base. Regardless of the form of manipulation used, the apparent goal is to produce facet joint separation and intradiscal pressure change. Evaluation of the thoracolumbar junction, sacroiliac articulations, and hip joints must also be included with identified dysfunctional changes corrected. While most chronic cases of spondylolysis and or spondylolisthesis are stable, it is possible for instability to occur with further slippage. If results of care using any form of manipulative therapy are not positive within a reasonable time (50% reduction in symptoms in 2–3 weeks), further evaluation including functional radiographic evaluation (stress studies) should be considered to rule out instability.

References

1. Yochum T. A new look at spondylolisthesis. Texas J Chiro 1986;4:19–23.
2. Wertzberger K, Peterson H. Acquired spondylolysis and spondylolisthesis in the young child. Spine 1980;5:437–442.
3. Yochum T, Rowe L. Essentials of Skeletal Radiology, 2nd ed. Baltimore: Williams & Wilkins, 1996.
4. Morita T, Ikata T, Katoh S, Miyake R. Lumbar spondylolysis in children and adolescents. J Bone Joint Surg 1995;77:620–625.
5. Werztberger K, Peterson H. Acquired spondylolysis and spondylolisthesis in the young child. Spine 1980;5:537–542.
6. Jackson D, Wiltse L, Dingeman D, Hayes M. Stress reactions involving the pars interarticularis in young athletes. Am J Sports Med 1981;9:304–312.
7. Muscik M, Hahnel H, Robinson PN, Perka C, Muscik C. Competitive sports and the progression of spondylolisthesis. J Pediatr Orthop 1996;16:364–369.
8. Maigne R. Diagnosis and Treatment of Pain of Vertebral Origin. Baltimore: Williams & Wilkins, 1996.
9. Schneiderman G, McLain R, Hambly M, Nielsen S. The pars defect as a source of pain: a histologic study. Spine 1995;20(16):1761–1764.
10. Toto B, Shapiro I. Diagnosis and treatment of spondylolysis in an adolescent athlete. Chiro Sports Med 1995;9(3):100–105.
11. Steiner M, Micheli L. Treatment of symptomatic spondylolysis and spondylolisthesis. Spine 1985;19(10):937–943.
12. Foster A, Ferrell R, Foster P. Spondylolisthesis in today's chiropractic: a case report. J Chiro 1990;27(11):73–74.
13. Peterson D, Bergmann T. Chiropractic Technique, 2nd ed. St. Louis: Mosby, 2002.
14. Mierau D, Cassidy D, McGregor M. A comparison of the effectiveness of spinal manipulative therapy for low back pain patients with and without spondylolisthesis. J Manipulative Physiol Ther 1987;10(2):49–55.
15. Robertson J. Intermittent lumbar flexion distraction applied in the treatment of spondylolisthesis: a statistical analysis. J Manipulative Physiol Ther 1979;2(3):159–169.
16. Cox J, Trier K. Chiropractic adjustment results correlated with spondylolisthesis instability. Man Med 1991;6(2): 67–72.

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GRAND ROUNDS DISCUSSION #2

A 16-year-old male was injured while participating in sports and presented with pain on extension in the low back. Following the injury, the athlete sought treatment from a chiropractor. After an examination, the chiropractor began providing manipulation, EMS, ultrasound, and stretching to the injured athlete. A short trial, a total of eight treatments, was provided. Radiographs were taken and revealed what appeared to be a unilateral spondylolysis at L5. A computed tomography (CT) scan revealed bilateral pars defect at L5; subsequently, a single-photon emission computed tomography (SPECT) bone scan was ordered, revealing increased radionuclide activity consistent with bilateral spondylolysis.

Following detection of the lesion via CT and SPECT, the athlete was treated with water exercises and placed in a Boston overlap brace 23 hours a day. The brace provided dynamic relief almost immediately. This brace was worn for 2 months with a follow-up CT showing a healed bilateral pars stress fracture. The patient was asymptomatic 2 years following the injury, returned, and was released to participate in all sports activities, including contact sports.

Incidence of Spondylolysis and Spondylolisthesis

The incidence of spondylolysis and spondylolisthesis in both the general population and athletic population varies in the literature. A number of these studies indicate a higher incidence of spondylolysis in symptomatic athletes than in the general asymptomatic nonathletic population where the pars interarticularis defect is estimated to occur in approximately 3–5% (1).

A study by Soler and Calderon reviewed 3,152 case histories of high-level athletes and found a higher prevalence of spondylolysis among athletes (8%). They went on to state that this was not much higher than the general population, which varies between 3% and 7% (2). In this study, 253 athletes (81 women and 172 men) had one or more spondylolytic lesions in the lumbar spine. Of the 253 subjects, 245 had lesions at one level and 8 had lesions at two levels. In 30% of the spondylolytic lesions, there was also evidence of spondylolisthesis (79 of 261 lesions). Of the 83 cases of spondylolytic lesions in women 34 showed evidence of spondylolisthesis (41%). Among the men, 45 of the 178 cases of spondylolysis (or 25.3%) also showed evidence of spondylolisthesis. The difference between these findings was statistically significant (chi-square test, $p < .05$) (2). The authors further report a ratio of male to female findings of spondylolysis within the general population of 2:1 which is increased in the sporting population to between 3:1 and 6:1.

Another study found the incidence of spondylolysis in the Caucasian adult population to be 3–6% but higher in Israeli soldiers (9.7%) and Canadian natives (13%). They also found a greater incidence in Caucasians versus African Americans (3 times higher) and in males versus females (2–3 times higher) (3). Incoming college football players in a division I level school underwent lumbar radiography. Review of 187 series revealed 4.8% with spondylolysis versus 6% of nonathletes in the control group (4). Conversely, a study of javelin throwers found 93% complained of back pain with and without radiologically demonstrated spondylolisthesis compared to 86% in the control group (5). It has also been reported that various disorders occur exclusively or more commonly in women, including spondylolisthesis, stress fractures in the pelvis and hip, and pelvic floor dysfunction (6).

A study of 100 female gymnasts using plain radiographs found spondylolysis in 11%, representing an almost 5-fold increase compared with the rate of 2.3% for the general Caucasian female population. Yet another study of 1,430 athletes utilizing review of radiographs found 15% incidence of spondylolysis for the group as a whole with divers, weightlifters, wrestlers, and gymnasts exhibiting a disproportionately higher rate within this group (7).

Soler and Calderon reported that 46.2% of 3,152 athletes with spondylolysis had a history of low back pain versus 23.5% with low back pain and no spondylolysis. They continue to state that there were no statistically significant differences found between sexes, location, or the existence of spondylolisthesis (2). Another study of 4,243 athletes demonstrated 590 of them revealed a radiographic diagnosis of spondylolysis in 484 men versus 106 women, a 4.5:1 ration (1).

Incidence by Sport

There have been reports of spondylolysis and spondylolisthesis occurring in many sports. It does appear that certain factors particular to a specific sport might be causative in nature. In general, stress fractures of the pars interarticularis have been reported to be caused by sports requiring repetitive loading and stress, shear forces (3), repetitive flexion, rotation and hyperextension (8), repetitive load-bearing hyperextension in the female athlete, torsion against resistance (2), and repeated loading in hyperflexion and hyperextension of the spine (1). Therefore, it would appear that sports requiring repetitive loading, shearing forces, and repetitive hyperflexion/hyperextension of the spine result in abnormal amounts of stress to the pars interarticularis, and, ultimately, stress fracture to the pars.

One sport in which spondylolysis is infrequently reported is swimming, although swimmers often complain of low back pain. A recent paper reported finding four adolescent elite swimmers who complained of low back pain (LBP) having spondylolysis. Three of the four swimmers participated in either the breaststroke or butterfly. Two cases were identified with plain-film radiography. CT scan revealed the lesion on both patients scanned and an increase in bone scan uptake was noted in all four (9).

Spondylolysis has been reported in a large number of sports including, diving, weightlifting, wrestling, modern pentathlon and triathlon, track and field, sailing, gymnastics, football, skiing, judo and martial arts, bobsleighing, cycling, fencing, tennis, canoeing, water skiing, boxing, water polo, swimming, synchronized swimming, rugby, volleyball, shooting, basketball, luge, rowing, ice and field hockey, handball, ice skating, equestrian, golf, and baseball (1), in addition to archery, badminton, basketball, boxing, mountaineering, paddleball, roller skating, rowing, shooting, soccer (2), dancing (10), and cricket (8). This is a partial list and should remind the clinician to include stress fracture of the pars in any athlete, male or female, regardless of the sport contested. It is conceivable that although a sport might have a low incidence of spondylolysis reported, training for competition in that sport could contain the components of repetitive stress, hyperflexion/hyperextension, and other factors suspected of causing spondylolysis.

The top five sports presenting with spondylolysis in this study (2) are listed in Table 1. The total number of athletes included in this study was 3,152 (2). Of interest is the number of athletes who actually presented with pain in this study. The top five sports reporting LBP are given in Table 2.

Another study showing the prevalence of spondylolysis in different sports and athletic populations presenting with low back pain lists the five sports with the highest incidence of spondylolysis (1) as shown in Table 3.

There were a total of 4,243 athletes in the above study with an incidence of 590 cases of spondylolysis, representing 13.9% overall. With 26 athletes competing in archery, none were found to have spondylolysis (1). The study by Soler and Calderon found only one case of spondylolysis out of 44 archers (2).

Upon review of the sports reporting spondylolysis, there appear to be some differences relative to the incidence per sport. There also seems to be a difference in age at the time of discovery of the spondylolysis. Soler and Calderon show the top three sports by age to be: mountaineering, equestrian, and paddleball, at 34.9%, 29.2%, and 26.4%, respectively (2). On the other hand, Rossi and Dragoni reported their findings in the 15- to 27-year-old group (1), but failed to break down the incidence by sport, relative to age. In contrast, the sports seen with an earlier incidence were: gymnastics, tennis, and badminton, exhibiting 14.3%, 15.2%, and 16.7%, respectively (2).

TABLE 1. The Top Five Sports Presenting with Spondylolysis in Study by Soler and Calderon (2)

Sport	Number	Percentage	Total number of athletes
Throwing	12	26.7	45
Bobsledding	3	20.0	15
Artistic gymnastics	19	17.0	112
Rowing	13	17.0	77
Boxing	3	14.3	21

TABLE 2. The Top Five Sports Reporting Low Back Pain in Study by Soler and Calderon (2)

Sport	Number	Percentage	Total number of athletes
Gymnastics	19	57.6	235
Artistic gymnastics	10	52.6	112
Track and field	32	52.5	685
Races	19	51.4	512
Combat sports	9	39.1	207

TABLE 3. The Top Five Sports with Highest Incidence of Spondylolysis in Study by Rossi and Dragoni (1)

Sport	Number	Percentage	Total number of athletes
Diving	23	40.4	57
Wrestling	20	25	80
Weightlifting	25	22.3	112
Modern pentathlon and triathlon	11	20.4	54
Track and field	61	17.3	353

The question arises as to how many of the athletes in any of these studies who were diagnosed with spondylolysis were acute versus chronic cases? How many athletes suffered an incidence of back pain and never sought care or had existing spondylolysis without ever having suffered back pain? How many athletes with spondylolysis remain pain free?

Signs and Symptoms

Athletes with existing spondylolysis may not present with low back pain. The pain, when present, may be the result of continued, repetitive movements, or a single event. When an athlete, particularly a young athlete, presents with a chief complaint of LBP immediately following a traumatic event, the examining physician must rule out spondylolysis as a cause. If the spondylolysis is symptomatic, the athlete typically presents with a complaint of focal LBP, although pain can occasionally extend into the buttock or proximal lower extremities (3), and has also been reported in the female as an ache with hyperextension of the spine and a rare report of sciatica (10).

There is one orthopedic test that has been described as having benefit in the diagnostic work-up of the athlete presenting with back pain when attempting to rule out spondylolisthesis. The test is termed the one-legged hyperextension maneuver (unilateral extension test or Michelis' test). The athlete is asked to stand on one leg in such a manner as to cause the lumbar spine to go into hyperextension. The maneuver is then repeated on the opposite side and can be found to be positive in some, but not all, athletes with active spondylolysis, generally on the ipsilateral side (3).

TABLE 4. Treatment and Imaging for Varying Stages of Pars Stress Fractures and Spondylolysis (10)

Stage of disease	Imaging	Treatment
Pars stress fracture	Bone scintigraphy or MRI	Activity restriction with or without bracing and physical therapy
Early spondylolysis	Bone scintigraphy, MRI,CT, oblique films	Activity restriction, bracing, and physical therapy
Progressive spondylolysis	MRI, CT, oblique films, bone scintigraphy	Rigid bracing, activity restrictions, and physical therapy
Terminal spondylolysis	MRI, CT, oblique films	Rare healing with bracing, internal fixation, permanent defect

Treatment

Treatment for spondylolysis ranges from conservative management to surgical stabilization. At this time, there does not appear to be a large, controlled trial related to the management of spondylolysis. Standaert et al. (3) reported the following three criteria for treatment objectives for patients with symptomatic spondylolysis:

1. Obtain healing of the fracture when possible.
2. Provide pain relief.
3. Optimize physical function and, were applicable, athletic performance, ideally with restoration of normal function (3).

One study of adolescent athletes found that 37% (average age 15.5 years) showed signs of union at the pars defects after treatment consisting of bracing for 2–6 months in lordosis (generally, the athlete is placed in 0° lordosis) (10). In addition to cessation of sports, hamstring stretching, and abdominal strengthening were initiated once pain was diminished. Of these patients, initially treated conservatively, 15% proceeded to surgical repair (3). In another study involving military personnel, only 2 of the 29 patients showed radiographic signs of pars healing after a 3-month follow-up. The conservative care consisted of restricted duty and full-time bracing for 3 months. The average age in this study was 21 years. Yet another study showed that patients with an average age of 16 had 18% healing with 6–12 months of bracing using a modified Boston overlap brace to prevent lumbar lordosis. This study only used plain-film radiography. There are a number of other studies showing varying degrees of healing using conservative measures ranging from 73% healing of early-stage spondylolysis versus 38.5% healing in those with progressive disease. Treatment of this group of 185 patients consisted of utilization of a "conventional lumbar corset" for 3–6 weeks, cessation of sports, and the use of an extension-limiting corset for 3–6 months. Rehabilitation was commenced once healing had been established by plain film radiography. The average age in this study was 13.9 years (3).

Use of the Boston overlap brace is described in detail in a paper by Omey et al. (10). The brace is molded in 0° lordosis to help unload the posterior elements and decrease shear stresses. The first 2–3 weeks are used to allow athletes to get used to the brace before requiring them to spend 23 hours per day braced. Initially, hamstring stretching is incorporated and later, as symptoms begin to subside, lumbar flexion exercises are begun along with abdominal stretching without wearing the brace. Progressively, the athletes' activities are increased, paying particular attention to reproducing movements similar to those experienced by the athlete in their respective sport as long as the athlete remains symptom free. When full sports activities can be performed while wearing the brace, gradual weaning from the brace may begin. The authors recommend not beginning this earlier then 4 months after the initiation of treatment as evidenced by CT scan. Each week, the brace is worn for 1 less hour and can take 6–12 months before the athlete is allowed to discontinue the use of the brace (10).

Nonsteroidal anti-inflammatory drugs, rest, and heat have also been found to decrease symptoms (10). Ralston and Weir describe treatment for varying stages of pars stress fractures/spondylolysis as well as imaging (11). Their recommendations are given in Table 4.

Chiropractic management of spondylolysis utilizing spinal manipulation of the segment above and below with specific high-velocity, low-amplitude manipulation may offer rapid symptomatic relief. There is no evidence that manipulation can reduce slippage. It should be noted that a recent study of spondylolysis patients treated with manipulation showed no significant difference compared to those treated for chronic low back pain with and without spondylolysis. Patients in this study had a history of chronic low back pain (12).

Yochum et al. refer to a study by Mierau et al. who treated 25 patients with spondylolisthesis and low back pain and 260 patients with low back pain alone by manipulation. Their findings showed good results with manipulation in 80% of those patients with spondylolisthesis and low back pain compared to 70% good results in the low back only patients. The number of treatments required were 6.9 and 7.5, respectively, indicating those with spondylolisthesis and low back pain responded slightly more quickly than those with low back pain only (11). The term "spondylo-athletic invalid" is used by Yochum et al. to describe athletes with spondylolisthesis who have inappropriately been told they cannot participate in athletic activities (13). The available literature does not support this restrictive approach to conservative treatment.

Whether an athlete who is returned to competition with spondylolisthesis faces greater risk for further slippage is not supported by the available literature. Athletic activity does not seem to be associated with any increased tendency for progression of spondylolisthesis. In 12% of athletes, a slip progression of >10% over an average follow-up period of 4.8 years was seen and only 1 out of 86 showed slippage of >20% (3). Spondylolisthesis rarely occurs from acute rather than recent acquired spondylolysis because the disc affords the vertebral motor unit considerable stability. Symptoms attributed to spondylolisthesis seem to originate more from segmental instability than from the degree of slippage (14).

Forty-seven patients under the age of 16 with symptomatic spondylolysis were followed for a mean of 7 years. In only two of these patients was slippage >20%. Other studies report similar findings indicating a small degree of progression occurring over varied periods of time (7).

In conclusion, conservative treatment provided to this athlete appears to be appropriate and should always be considered prior to a more aggressive form of treatment. There is also a necessity for further randomized controlled trials (RCTs) related to several issues:

1. Long-term effects of conservative versus surgical treatment of symptomatic spondylolysis
2. What type(s) of conservative treatment are most beneficial to the athlete
3. Long-term effects of additional slippage in the active athlete with spondylolysis
4. Identification of at-risk sports and at-risk population of athletes
5. Suggested prophylaxis

Until the data support otherwise, conservative treatment should be provided for the symptomatic acute patient as outlined above, followed by a return to athletic activities when asymptomatic. The treatment provided to this athlete is appropriate and demonstrates healing utilizing conservative measures.

References

1. Rossi F, Dragoni S. The prevalence of spondylolysis and spondylolisthesis in symptomatic elite athletes: radiographic findings. Radiography 2001;7:37–42.
2. Soler T, Calderon C. The prevalence of spondylolysis in the Spanish athlete. Am J Sports Med 2000;28(1):57–62.
3. Standaert CJ, Herring SA, Halpren B, King O. Spondylolysis. Phys Med Rehab Clin North Am 2000;11(2):785–803.
4. Jones DM, Tearse DS, Koury GY, Kathol MH, Brandser EA. Radiographic abnormalities of the lumbar spine in college football players: a comparative analysis. Am J Sports Med 1999;27(3):335–338.
5. Schmitt H, Broci DR, Carstens C. Long-term review of the lumbar spine in javelin throwers. J Bone Joint Surg 2001;83(3):324–327.
6. Teitz CC, Hu SS, Arendt EA. The female athlete: evaluation and treatment of sports-related problems. J Am Acad Orthop Surg 1997;5(2):878–896.
7. Standaert CJ, Herring SA. Spondylolysis: a critical review. Br J Sports Med 2000;34:415–422.
8. Elliott BC. Back injuries and the fast bowler in cricket. J Sports Sci 2000;18(12):983–991.
9. Myska M, Constantini N, Cale Benzoor M, Back Z, Kahn G, Mann G. Spondylolysis as a cause of low back pain in swimmers. Int J Sports Med 2000;21(5):375–379.
10. Omey LO, Micheli LJ, Gerbino PG. Idiopathic scoliosis and spondylolysis in the female athlete. Clin Orthop 2000;372:74–84.
11. Ralston S, Weir M. Suspecting lumbar spondylolysis in adolescent low back pain. Clin Pediatr 1998;37(5):287–293.
12. Gatterman MI, Panzer D. Disorders of the lumbar spine. In Gatterman MI, ed., Chiropractic Management of Spine Related Disorders. Baltimore: Williams & Wilkins, 1990:156–157.
13. Yochum TR, Rowe LJ, Barry MS. Natural history of spondylolysis and spondylolisthesis. In Yochum TR, Rowe LJ, eds., Essentials of Skeletal Radiology. Baltimore: Williams & Wilkins, 1996:337, 362.
14. Banks SD. Lumbar spine injuries. In Hyde TE, Gengenbach MS, eds., Conservative Management of Sports Injuries. Baltimore: Williams & Wilkins, 1996:201–202.

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FINAL DISCUSSION

The presented case study is a classic example of what many clinicians face when evaluating a patient with radiographic evidence of spondylolysis or spondylolisthesis. The optimal clinical decision making is guided by physiological imaging to determine whether these lesions are active or not. Most pars defects in patients with spondylolisthesis will not have positive bone scans or bone marrow edema on magnetic resonance imaging (MRI) scans. This case study is a classic demonstration of the active athlete, with positive physiological imaging studies, who needs appropriate bracing and reduction in sports-related physical activity until the imaging studies demonstrate a return to normal. The discussions presented here highlight the overall assessment, management, and treatment of this type of patient.

Questions are often raised about participation in contact sports or heavy lifting in the work environment. As this case study demonstrates, the real key in the clinical decision-making process is not only the use of physical examination findings and conventional radiographs, but some form of physiological imaging such as SPECT bone scan or MRI to determine the active or inactive nature of spondylolysis or spondylolisthesis. This thought process is a change in the paradigm towards the evaluation and treatment of patients with low back pain, who present with conventional radiographs showing pars defects and/or spondylolisthesis. The use of conventional radiography in the assessment of patients with low back pain and spondylolisthesis is not adequate to determine whether the spondylolysis or spondylolisthesis is indeed active and the direct source of their back pain. Yochum and Rowe (1) have offered an algorithmic approach to the diagnosis and treatment of patients with spondylolysis and/or spondylolisthesis. This algorithmic approach deals with diagnostic physiological imaging (SPECT bone scan or MRI) as the nucleus to determine whether spondylolysis or spondylolisthesis is clinically active or inactive.

The scope of this case study does not allow a detailed discussion of the most common causes of back pain in patients with spondylolisthesis. Most of these patients have functional biomechanical alterations and their back pain is not directly associated with the presence of spondylolisthesis. Therefore, most techniques used to treat low back pain will be effective. This concept should help the clinician to "look past" the spondylolisthesis as a cause for their low back pain. Biomechanical dysfunction of the sacroiliac joints and lower lumbar facet syndrome are the most common causes of back pain in patients with radiographically inactive spondylolysis and/or spondylolisthesis (1,2). A more detailed discussion concerning the treatment of patients with spondylolisthesis is provided by Cox (2), Illi (3), Cassidy and Kirkaldy-Willis (4), Bergmann et al. (5), and others.

References

1. Yochum TR, Rowe LJ. Essentials of Skeletal Radiology, 2nd ed. Baltimore: Williams & Wilkins, 1996.
2. Cox J, Trier K. Chiropractic adjustment results correlated with spondylolisthesis instability. Man Med 1991; 6(2): 67–72.
3. Illi FW. The Vertebral Column: Lifeline of the Body. Chicago: National College of Chiropractic, 1951.
4. Cassidy JD, Potter GE, Kirkaldy-Willis WH. Manipulative management of back pain in patients with spondylolisthesis. J Can Chiro Assoc 1978; 22:15.
5. Peterson D, Bergmann T. Chiropractic Technique, 2nd ed. St. Louis: Mosby, 2002.

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