Understanding and Treating Spondylolysis and Spondylolisthesis

By Tenner Guillaume, M.D., pediatric spine surgeon

When an athletic adolescent experiences low back pain that worsens with back extension, consider evaluating the patient for spondylolysis.

Spondylolysis is an acquired fracture of the pars interarticularis of the vertebra, but the term can also be used to describe a stress fracture of the pars interarticularis. The defects can be unilateral or bilateral and are commonly seen at L5.

Spondylolysis affects 6 percent of people by age 18. When it is symptomatic, it is a painful condition that can sideline gymnasts, offensive linemen, ballet dancers, divers or any other athletes whose sport calls for hyperextension. The incidence in athletes is 11 percent compared to 3 percent among nonathletes. As many as 11 percent of female gymnasts may experience spondylolysis.

Spondylolysis can often be resolved with rest, bracing and physical therapy, but 43 to 76 percent of cases of bilateral spondylolysis will progress to spondylolisthesis, a condition in which one of the vertebrae (usually L5) slips forward compared to the next vertebrae (often S1). It is important to note that spondylolisthesis may also develop without a previous history of spondylolysis, but because they are often related, this article will examine the diagnosis and treatment of each condition.

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Making a Differential Diagnosis of Spondylolisthesis

History
Usually patients report low back pain that can be acute or insidious. Because spondylolisthesis is acquired and secondary to mechanical stress, the history should include a discussion of the patient’s physical activities.

Physical Examination
When a thorough history has eliminated red flags such as constitutional symptoms or radiculopathy, the following symptoms point to a high suspicion of spondylolisthesis.

• Pain that is precipitated by or exacerbated during physical activity or athletics.
• Pain with sneezing or coughing.
• Pain and/or weakness with kneeling or lifting.
• Pain with or without radiating symptoms.
• Neurological deficits such as paresthesias, numbness, or loss of motor function.

Management of Spondylolisthesis
Most patients, symptoms tend to resolve within 12 weeks with a regimen of rest and physical therapy.

1. Rest for the first four to six weeks by avoiding sports and other activities that strain it.
2. Wear a lumbar back brace (LSO). This recommendation depends on acuity, radiographic findings and the patient’s age and willingness to rest. It can be provider dependent.
3. After six to eight weeks, patients should participate in physical therapy for six weeks. If prescribed, the LSO should be removed during physical therapy, which should include lumbar core strengthening exercises and hamstring stretching. Avoid active hamstring stretch during therapy.
4. At 12 weeks patients may begin a jogging program for two weeks and then progress to running. If patients remain pain-free while running they may resume participating in their sport. However, patients should use backward walkers and back handgrips until physical therapy is completed.

Surgical interventions are rarely needed.

Making a Differential Diagnosis of Spondylolisthesis
Spondylolisthesis refers to a vertebral slip that usually occurs between L5 and S1. Very rarely, it can be present at both and remain asymptomatic. Spondylolisthesis may occur before spondylolysis. For example, in cases of bilateral spondylolisthesis, the posterior articulations may no longer provide posterior stability, and anterior slipping of the L5 vertebra over the sacrum can occur. Approximately one-third of symptomatic patients have spondylolysis without spondylolisthesis.

There are four types of spondylolisthesis, but only two—dysplastic and isthmic—occur in children and adolescents. Dysplastic spondylolisthesis happens when a congenital deficiency in the L5-S1 facet joints allows a slippage to occur. A defect in the pars interarticularis leads to isthmic spondylolisthesis, which is the most common type.

History
As with spondylolysis, spondylolisthesis is more common among people whose activities put stress on the lower back and require frequent extensions of the lumbar spine. Asking patients about their physical activities will provide valuable insight.

Pain is the most common presenting symptom of spondylolisthesis. It manifests as a dull, aching low back discomfort, either localized to the low back or with some radiation into the buttocks and posterior thighs.

Physical Examination
Check for:
• Postural deformity or abnormal gait resulting from tight hamstrings.
• Flatfoot of the buttok.
• Increased lumbar lordosis.
• A waddling gait.

Appropriate Imaging
Request AP and lateral radiographs of the lumbar spine and spot lateral views of L5-S1 for help visualizing any defects.

Management of Spondylolisthesis
In most cases, spondylolisthesis is managed with rest and physical therapy as described above. Pain associated with spondylolisthesis can be managed with nonsteroidal anti-inflammatory medications.

When to Refer
Patients who have radiating symptoms suggestive of nerve root compression or radiculopathy should be referred to a spine specialist promptly. When there is no sign of neurologic compromise, it is appropriate to manage patients who have spondylolisthesis with simple rest. However, if rest for four to six weeks does not resolve pain and other symptoms, please refer patients suspected of having spondylolisthesis to one of our spine specialists. Gillette’s spine specialists welcome your questions, requests for consultation and referrals regarding any patient who is suspected of having spondylolysis or spondylolisthesis.

Conclusion
Spondylolysis and spondylolisthesis are common, acquired, secondary to mechanical stress, and most often seen in athletes. In almost all cases, both conditions can be resolved within 12 weeks with rest, physical therapy and bracing. Very rarely, surgery may be required in order to relieve persistent pain associated with spondylolisthesis.

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Hockey Player With Spondylolytic Spondylolisthesis

Hickey
This 15-year-old male hockey player was seen in clinic for intense low back pain which had started three weeks earlier. He reported a history ofchronic low back pain rated at 5/10 in intensity with longstanding activities. However, during recent preseason training, the pain had become increasingly severe. He said that while playing, he often noticed tingling or paresthesias in his buttocks which would occur with extension or upon extension of his spine. He had been sitting out of hockey for two weeks prior to his clinic appointment. While he was benzched, he noted that the severity of the pain was somewhat reduced. He did not have pain radiating down either lower extremity or any changes in bowel or bladder function. He did not have any associated constitutional symptoms such as fevers, night sweats or unintentional weight loss.

Physical Examination
The physical examination demonstrated a healthy young male with good bilateral lower extremity strength and sensation without any evidence of upper motor neuron findings such as hyperreflexia, clonus or Babinski. He did not have much pain during forward flexion of the lumbar spine, but extension acutely increased his low back pain.

AP and L5-S1 spot lateral radiographs were obtained and an L5-S1 dual photon absorptiometry was obtained. An MRI had been done at another clinic, and increased signal intensity was noted bilaterally on both T1 and T2 (short tau inversion recovery) sequences within the pedicles and pars interarticularis. These find-
ings support an acute exacerbation of his chronic spondylolisthesis.

Treatment
Given the acuity of the pain crisis and the increased signal intensity noted on the MRI, a brace and rest were the best initial treatments. Our treatment goals were symptom relief and prevention of future pain recurrences. The patient and his parents understood that a union brace was unlikely.

For the first six weeks of treatment, the patient was expected to wear the brace 23 hours a day, but he could remove it when showering or swimming. After six weeks, he returned to the clinic and his pain was significantly improved. We then initiated a physical therapy program to work on isometric core strengthening and hamstring stretching. The patient was told that he could remove the brace during physical therapy and when sleeping. However, they should wear it at all other times. During an appointment 6 weeks after treatment was initiated, the patient reported that he had been pain-free for the preceding six weeks. Consequently, he was allowed to remove his brace and began a supervised jogging program and cutting time for the next six to fourteen weeks. If he remained pain-free, he could return to sports full-time without restrictions.

Follow-up
He has now been pain-free for two years, and he has maintained his core strengthening program throughout.

Fig. 2 - Spondylolysis
A 15-year-old male hockey player with spondylolysis and spondylolisthesis. Although the CT scan provides higher resolution of the bony anatomy, the radiograph usually provides sufficient detail.

Fig. 3 - Spondylolytic spondylolisthesis
This spot lateral radiograph of L5-S1 demonstrates the spondylolytic spondylolisthesis. The spinous processes and the lateral margins of L5-S1 are visible.

Fig. 4 - Spondylolisthesis
In this sagittal MRI STIR sequence, the abnormal signal intensity (bony edema) at the site of spondylolysis. Note the involvement of the L5 pedicle and pars interarticularis that is associated with an acute spondylolytic spondylolisthesis.
Making a Differential Diagnosis of Spondylolisthesis

History

Usually patients report low back pain that can be acute or insidious. Because spondylolysis is acquired and secondary to mechanical stress, the history should include a discussion of the patient’s physical activities.

Physical Examination

When a thorough history has eliminated red flags such as constitutional symptoms or radiculopathy, the following symptoms point to a high suspicion of spondylolysis:

- Recent onset with laminites with spondylolysis and single leg stance.
- Hamstring tightness.
- Popliteal angles are high.

Appropriate Imaging

Request AP and lateral radiographs of the lumbar spine. If the patient experiences pain below the inter-axial line, obtain spot lateral views of L5-S1 for help visualizing any defect. Oblique films are no longer recommended.

If the radiograph proves negative, but the history and physical point to spondylolysis, an MRA can further characterize the nature of the injury unilateral or bilateral and the presence or absence of a stress injury or acute stress disruption.

Management of Spondylolysis

For most patients, symptoms tend to resolve within 12 weeks with a regimen of rest and physical therapy.

- Rest the back for four to six weeks by avoiding sports and other activities that strain it.
- Wear a lumbar support brace (LSO). This recommendation depends on acuity, radiographic findings and the patient’s age and willingness to rest. It can be provider-dependent.
- After four to six weeks of rest, patients should participate in physical therapy for six weeks. If prescribed, the LSO should be removed during physical therapy, which should include lumbar core strengthening exercises and hamstring stretching. Avoid active lumbar extension during therapy.
- At 12 weeks mark, patients may begin a yoga program for two weeks and then progress to running. If patients remain pain-free while running they may resume participating in their sport. However, patients should avoid backward walking and backward hiking until physical therapy is completed.
- Surgical interventions are rarely needed.

Making a Differential Diagnosis of Spondylolisthesis

Spondylolisthesis refers to a vertebral slip that usually occurs between L5 and S1. Very rarely, it can be present at both and remain asymptomatic. Spondylolisthesis may occur before spondylolysis. For example, in cases of bilateral spondylolysis, the posterior articulations may no longer provide posterior stability and anterior slipping of the L5 vertebrae over the sacrum can result. However, approximately one-third of symptomatic patients have spondylolysis without spondylolisthesis.

There are four types of spondylolisthesis, but only two—dysplastic and isthmic—occur in children and adolescents. Dysplastic spondylolisthesis happens when a congenital deficiency in the L5-S1 facet joints allows a slip to occur. A defect in the pars interarticularis leads to isthmic spondylolisthesis, which is the most common type.

History

As with spondylolysis, spondylolisthesis is more common among people whose activities put strain on the lower back and require frequent extensions of the lumbar spine. Asking patients about their physical activities will provide valuable insight.

The most common presenting symptom of spondylolisthesis is pain. It manifests as a dull, aching low back discomfort, either localized to the low back or with some radiation into the buttocks and posterior thighs.

Physical Examination

Check for:
- Postural deformity or abnormal gait resulting from tight hamstring.
- Flattening of the buttocks.
- Increased lumbar lordosis.
- A walking gait.

Appropriate Imaging

Request AP and lateral radiographs of the lumbar spine and spot lateral views of L5-S1 for help visualizing any defects.

Management of Spondylolisthesis

In most cases, spondylolisthesis is managed with rest and physical therapy as described above. Pain associated with spondylolisthesis can be managed with nonsteroidal anti-inflammatory medications.

When to Refer

Patients who have radiating symptoms suggestive of nerve root compression or radiculopathy should be referred to a spine specialist promptly. When there is no sign of neurologic compromise, it is appropriate to manage patients who have spondylolisthesis with simple rest. However, if rest for four to six weeks does not resolve pain and other symptoms, please refer patients suspected of having spondylolisthesis to one of our spine specialists. Gillette’s spine specialists welcome your questions, requests for consultation and referrals regarding any patient who is suspected of having spondylolysis or spondylolisthesis.

Conclusion

Spondylolysis and spondylolisthesis are common, acquired, secondary to mechanical stress, and more often seen in athletes. In almost all cases, both conditions can be resolved within 12 weeks with rest, physical therapy and bracing. Very rarely, surgery may be required in order to relieve persistent pain associated with spondylolisthesis.

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Hockey Player With Spondylolytic Spondylolisthesis

History

This 15-year-old male hockey player was seen in clinic for intense low back pain which had started three weeks earlier. He reported a history of chronic low back pain related to growing with increasing physical activities. However, during recent pre-season training, the pain had become increasingly severe. He said the pain was made worse by activities that involved hyperextension of the spine such as bending backwards or upon extension of his spine. He had been sitting out of hockey for two weeks prior to his clinic appointment. While there was not too much pain, he was bothered by the severity of the pain which was some-

what reduced. He did not have pain radiating down either lower extremity or any changes in bowel or bladder function. He did not have any associated constitutional symptoms such as fever, chills, night sweats or unintentional weight loss.

Physical Examination

The physical examination demonstrated a healthy young male with good bilateral lower extremity strength and sensation without any evidence of upper motor neuron findings such as hyperreflexia, clonus or Babinski. He did not have much pain during forward flexion of the lumbar spine, but extension accentuated his increased low back pain.

AP and L5-S1 spot lateral radiographs were obtained and an L5-S1 spondylolytic spondylolisthesis noted. An MRA had been done at another clinic, and increased signal intensity was noted bilaterally on both T2 and STIR (short tau inversion recovery) sequences within the pelvic and lumbosacral intertransverse. These find-
ings support an acute exacerbation of his chronic spondylolysis.

Treatment

Given the acuity of the pain crisis and the increased signal intensity noted on the MRI, a brace and rest were the best initial treatments. Our treatment goals were symptom relief and preven-
tion of future pain recurrences. The patient and his parents understood that a union of bone was unlikely.

For the first six weeks of treatment, the patient was expected to wear the brace 23 hours a day, but he could remove it when showering. After six weeks, he returned to the clinic and his pain was significantly improved. We then initiated a physical therapy program to work on isometric core strengthening and hamstring stretching. The patient was told that he could remove the brace during physical therapy and when sleeping. However, he should wear it at all other times. During an appointment 2 weeks after treatment was initiated, the patient reported that he had been pain-

free for the preceding six weeks. Consequently, he was allowed to remove his brace and began a supervised jogging routine and return to sports for the next few to six weeks. If he remained pain-free, he could return to sports full time without restrictions.

Follow-up

He has now been pain-free for two years, and he has maintained his core strengthening program throughout.
Making a Differential Diagnosis of Spondylolisthesis

History

Usually patients report low back pain that can be acute or insidious. Because spondylolisthesis is acquired and secondary to mechanical stress, the history should include a discussion of the patient’s physical activities.

Physical Examination

When a thorough history has eliminated red flags such as constitutional symptoms or radiculopathy, the following symptoms point to a high suspicion of spondylolisthesis:

- Patient with spondylolisthesis and isthmic—occur in children and adolescents. Dysplastic spondylolisthesis happens when a congenital deficiency in the bone leads to slippage to occur. A defect in the pars interarticularis leads to isthmic spondylolisthesis, which is the most common type.

History

As with spondylolysis, spondylolisthesis is more common among people whose activities put stress on the lower back and require frequent extensions of the lumbar spine. Asking patients about their physical activities will provide valuable insight.

Conclusion

Spondylolysis and spondylolisthesis are common, acquired, secondary to mechanical stress, and more often seen in athletes. In almost all cases, both conditions can be resolved within 12 weeks with rest, physical therapy and bracing. Very rarely, surgery may be required in order to relieve persistent pain associated with spondylolisthesis.

References


Hockey Player With Spondylolytic Spondylolisthesis

History

This 15-year-old male hockey player was seen in clinic for intense low back pain which had started three weeks earlier. He reported a history of chronic low back pain rated seven to eight out of ten while engaging in many activities. However, during recent preseason training, the pain had become increasingly severe. He said having to stop or pace himself while skating or when moving backwards or upon extension of his spine. He had been sitting out of hockey for two weeks prior to his clinic appointment. While he was bowed, he noted that the severity of the pain was somewhat reduced. He did not have pain radiating down either lower extremity or any changes in bowel or bladder function. He did have any associated constitutional symptoms such as fevers, chills, night sweats or unintentional weight loss.

Physical examination

The physical examination demonstrated a healthy young male with good bilateral lower extremity strength and sensation without any evidence of upper motor neuron findings such as hyperreflexia, clonus or Babinski. He did not have much pain during forward flexion of the lumbar spine, but extension accentuated his increased low back pain.

AP and L5 spot lateral radiographs were obtained and an L5-S1 spondylolysis and spondylolisthesis was noted. An MRI had been done at another clinic, and increased signal intensity was noted bilaterally on both T2 and STIR (short tau inversion recovery) sequences within the pedicles and pars interarticularis. These findings support an acute exacerbation of his chronic spondylolisthesis.

Treatment

Given the acuity of the pain crisis and the increased signal intensity noted on the MRI, a brace and rest were the initial treatments. Our treatment goals were symptom relief and prevention of future pain recurrences. The patient and his parents understood that a union of bone was unlikely.

For the first six weeks of treatment, the patient was instructed to wear the brace 23 hours a day, but he could remove it when showering or engaging in activities such as reading or writing. During an appointment in six weeks after treatment was initiated, the patient reported that he had been pain-free for the preceding six weeks. Consequently, he was slowly allowed to remove his brace and begin a supervised jogging program and skiing. At the four to six week follow-up, he was pain-free and could return to sports full-time without restrictions.

Follow-up

He has now been pain-free for two years, and he has maintained his core strengthening program throughout.
Understanding and Treating Spondylolysis and Spondylolisthesis

By Tenner Guillaume, M.D., pediatric spine surgeon

Tenner Guillaume, M.D., is a board-certified orthopedic surgeon who specializes in managing spine conditions such as pediatric congenital and idiopathic scoliosis, spondylolysis and isthmic spondylolisthesis. He received his medical degree from the University of Minnesota Medical School. He completed an internship and residency at the University of California, San Francisco Medical Center and a spine surgery fellowship through the Twin Cities Spine Center in Minneapolis.

He has presented research, posters and abstracts and has professional publications. He is a member of the American Academy of Orthopaedic Surgeons and the North American Spine Society. He is a candidate for membership in the American Academy of Pediatrics and the American Academy of Neurology. He is also a member of the American Orthopaedic Association, the American Neurological Association, the American Academy of Neurology, the American Academy of Neurology and the American Academy of Neurology.

Spondylolysis is an acquired fracture of the pars interarticularis of the vertebra, but the term can also be used to describe a stress fracture of the pars interarticularis. The defects can be unilateral or bilateral and are commonly seen at L5. Spondylolysis affects 6 percent of people by age 18. When it is symptomatic, it is a painful condition that can sideline gymnasts, offensive linemen, ballet dancers, divers or any other athletes whose sport calls for hyperextension. The incidence in athletes is 11 percent compared to 3 percent among nonathletes. As many as 11 percent of female gymnasts may experience spondylolysis.

Spondylolisthesis refers to a vertebral slip that usually occurs between L5 and S1. Of the four kinds of spondylolisthesis, only two—dysplastic and isthmic—occur in children and adolescents. Spondylolysis and spondylolisthesis are common, secondary to mechanical stress, and more often seen in athletes.

Usually both conditions can be resolved within 12 weeks with rest, physical therapy and bracing.
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Spondylolysis is an acquired fracture of the pars interarticularis of the vertebra. The tears can be unilateral or bilateral and are commonly seen at L5. Spondylolysis affects 6 percent of people by age 18. When it is symptomatic, it is a painful condition that can sideline gymnasts, offensive linemen, ballet dancers, divers or any other athletes whose sport calls for hyperextension. The incidence in athletes is 11 percent compared to 3 percent among nonathletes. As many as 12 percent of female gymnasts may experience spondylolysis.

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KEY INSIGHTS

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- Spondylolisthesis refers to a vertebral slip that usually occurs between L5 and S1.
- Of the four kinds of spondylolisthesis, only two—dysplastic and isthmic—occur in children and adolescents.
- Spondylolysis and spondylolisthesis are common, acquired, secondary to mechanical stress, and more often seen in athletes. Usually both conditions can be resolved within 12 weeks with rest, physical therapy and bracing.

Fig. 1a - Pars Interarticularis

Fig. 1b - Pars Interarticularis With Spondylolysis

Typically both conditions can be resolved within 12 weeks with rest, physical therapy and bracing.

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