

## Understanding and Treating Spondylolysis and Spondylolisthesis

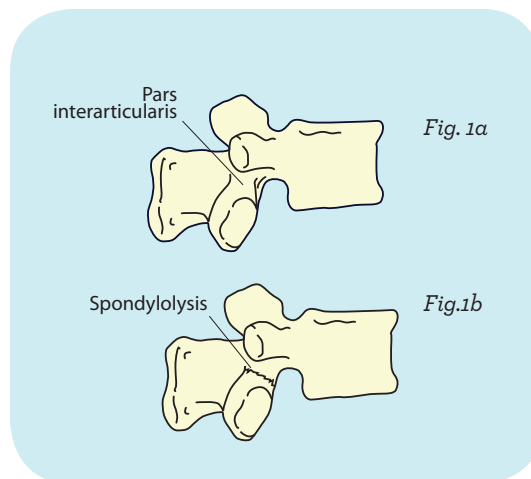
By **Tenner Guillaume, M.D., pediatric spine surgeon**

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<sup>1</sup>. 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<sup>2,3</sup>. As many as 11 percent of female gymnasts may experience spondylolysis<sup>4</sup>.

Spondylolysis can often be resolved with rest, bracing and physical therapy, but 43 to 74 percent of cases of bilateral spondylolysis will progress to spondylolisthesis<sup>5,6</sup>, a condition in which one of the vertebrae (usually L5) slips forward compared to the next vertebra (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.



*Fig. 1a - Pars Interarticularis*

*Fig. 1b - Pars Interarticularis With Spondylolysis*

### KEY INSIGHTS

- 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.
- 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.

## Making a Differential Diagnosis of Spondylolysis

### 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:

- Pain worsens with lumbar extension and single leg stance extension.
- Hamstrings are tight.
- Popliteal angles are high.

### Appropriate Imaging

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

If the radiographs prove negative, but the history and physical point to spondylolysis, an MRI can further characterize the nature of the injury: unilateral or bilateral and the presence or absence of a pars stress injury or acute pars 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 lumbosacral orthosis (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 the 12-week mark, 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, gymnasts should save backward walkovers and back handsprings until physical therapy is completed.

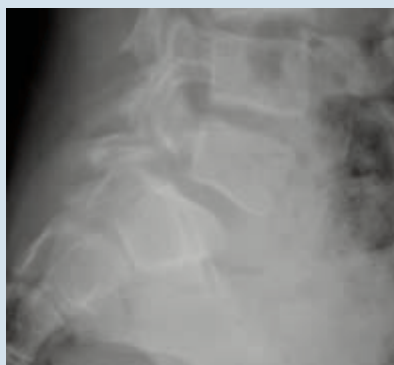
Surgical interventions are rarely needed.

## 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 birth and remain asymptomatic. Spondylolysis may occur before spondylolisthesis. For example, in cases of bilateral spondylolysis, the posterior articulations may no longer provide posterior stability, and anterior slipping of the L5 vertebra over the sacrum can result. However, approximately one-third of symptomatic patients have spondylolisthesis without spondylolysis.



**Fig. 2 - Spondylolysis**  
In this sagittal CT scan, a pars interarticularis disruption (spondylolysis) is evident. Although the CT scan provides higher resolution of the bony anatomy, a radiograph usually provides sufficient detail.



**Fig. 3 - Spondylolytic spondylolisthesis**  
This spot lateral radiograph of L5-S1 demonstrates a Grade I L5-S1 spondylolytic spondylolisthesis.



**Fig. 4 - Acute spondylolysis**  
Sagittal MRI (STIR sequence) demonstrates the increased signal intensity (bony edema) at the site of stress. Note the inflammation in the L5 pedicle and pars interarticularis that is associated with an acute spondylolysis.

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
- Flattening of the buttocks
- 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 often 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 spondylolysis with simple rest. However, if rest for four to six weeks does not resolve pain and other symptoms, please refer patients suspected of having spondylolysis 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.

## References

- <sup>1</sup> Beutler WJ, Frederickson BE, Murtland A, et al. The natural history of spondylolysis and spondylolisthesis: 45-year follow-up evaluation. *Spine (Phila PA 1976)* 2003; 28: 1027-1035.
- <sup>2</sup> Swärd L, Hellström M, Jacobsson B, Peterson L. Spondylolysis and the sacro-holateral angle in athletes. *Acta Radiol* 1989; 30: 359-364.
- <sup>3</sup> Kono SH, Nasha-Hara G. A study on the etiology of spondylolysis, with reference to athletic activities. *J Jap Orthop Assoc* 1975; 49: 125-133.
- <sup>4</sup> Jackson DW, Wiltse LL, Cirincione RJ. Spondylolysis in the female gymnast. *Clin Orthop Relat Res* 1976; 117: 68-73.
- <sup>5</sup> Beutler WJ, Frederickson BE, Murtland A, et al. The natural history of spondylolysis and spondylolisthesis. *J Bone Joint Surg Am* 1984; 66: 699-707.
- <sup>6</sup> Crawford CH, Ledonio CGT, Bess RS, Buchowski JM, et al. Current Evidence Regarding the Etiology, Prevalence, Natural History, and Prognosis of Pediatric Lumbar Spondylolysis: A Report from the Scoliosis Research Society Evidence-Based Medicine Committee. *Spine Deform* 2015; 3: 12-29.



## 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 mild low back pain associated with sporting activities. However, during recent preseason training, the pain had become increasingly severe. He said that it was worse when skating 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 benched, 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, 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 hyper-reflexia, 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 Grade I spondylolytic 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. Those findings suggest an acute exacerbation of his chronic spondylolysis.

### Treatment

Given the acuity of the pain onset 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 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 12 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 begin a supervised jogging, running and skating program for the next two to four 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.

## Author PROFILE



**Tenner Guillaume, M.D.**

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 Scoliosis Research Society and the Pediatric Orthopaedic Society of North America.

ADDRESS SERVICE  
REQUESTED



## A Pediatric PERSPECTIVE

**A Pediatric Perspective** focuses on specialized topics in pediatrics, orthopedics, neurology, neurosurgery and rehabilitation medicine.

To subscribe to or unsubscribe from **A Pediatric Perspective**, please send an email to [Publications@gillettechildrens.com](mailto:Publications@gillettechildrens.com).

Editor-in-Chief - Steven Koop, M.D.  
Editor - Ellen Shriner  
Designer - Becky Wright

Copyright 2015, Gillette Children's Specialty Healthcare. All rights reserved.



To make a referral, call 651-325-2200 or 855-325-2200 (toll-free).



Visit [gillettechildrens.org/care-team](http://gillettechildrens.org/care-team) to learn more about Gillette's specialists.

### Clinical Education

Visit our website to find videos and professional presentations. [gillettechildrens.org](http://gillettechildrens.org)

### Back Issues of **A Pediatric Perspective**

[gillettechildrens.org/for-medical-professionals/publications](http://gillettechildrens.org/for-medical-professionals/publications)

Gillette Children's Specialty Healthcare is named in honor of orthopedic surgeon Arthur Gillette, M.D., who helped found the nation's first hospital for children who have disabilities. We are an independent, not-for-profit children's hospital, and our organization has no affiliation with the Gillette Company or the Gillette brand of personal care products.

## NEWS & NOTES

### *Use One-Call Access for Express Access to Gillette*

Gillette's One-Call Access phone number makes it easy to reach Gillette for patient referrals, physician consultations and hospital admissions.

### **Physicians and other medical providers can simply call 651-325-2200 or 855-325-2200 (toll-free).**

With a single call, you will reach a registered nurse who can:

- Connect you to a specific physician or on-call specialist
- Arrange for a patient admission (24-hour coverage)
- Expedite the patient intake process
- Coordinate patient referrals and appointments
- Provide detailed follow-up regarding your patient's referral

A registered nurse answers calls Monday through Friday, 8 a.m. to 5 p.m.

### *Check Out These Clinical Videos*

Tenner Guillaume, M.D., covers the key steps for assessing back pain in children.

[gillettechildrens.org/backpain](http://gillettechildrens.org/backpain)

Learn more about complex movement disorders and the spectrum of treatments available.

[gillettechildrens.org/CMD](http://gillettechildrens.org/CMD)