

Spine Hypermobility in Sports

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ABSTRACT

Spondylolysis and 1st degree spondylolisthesis are one of the common conditions causing low back pain in athletes. Treatment options are very variable and often controversial. Misdiagnosis and inappropriate treatment increases risk of reoccurrence in such conditions. It may also cause decrease in an athlete's performance if not treated well. Conservative management includes functional rehabilitation and anti-lordotic bracing. Therapy medium if given in right manner will have positive therapeutic effects. If conservative management fails to show any improvement, surgical stabilization with spinal fusion may be considered.

Keywords: Spondylolysis, Spondylolisthesis, Functional rehabilitation, Athlete.

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INTRODUCTION

Spondylolysis is a loss of the structural integrity of the vertebral pars interarticularis. The cause of spondylolysis is not yet really clear. It seems to be a congenital dysplasia in the isthmus of a vertebra¹ that develops after the birth or a congenital failure of bony closure. Spondylolysis occurs most frequently at the fifth vertebral level (L5), though it can also be found at L4 and very rare at more proximal levels. In adults, spondylolysis is found in 5 to 7% and many are asymptomatic.² It is reported that the frequency is increasing in athletes up to 26.5%.³ Spondylolysis is defined as a stress or fatigue fracture of the pars interarticularis caused by recurring trauma resulting from repeated flexion and hyperextension and twisting (Fig. 1). These repetitive movements cause a shearing stress to the vertebra resulting in the stress fracture.⁴ The developing instability that results can then be exacerbated by sporting activities that emphasize back extension, especially gymnastics, swimming, apparatus gymnastics, football and American rules football.⁵ Spondylolisthesis involves a relative anterior slipping of one vertebra over those below it. This is associated with bilateral spondylolysis⁶ and is more likely to be seen during the rapid growth spurt of early adolescence⁷ (Fig. 2). Common used is Wiltse's classification of spondylolisthesis (percentage of slipping of the upper displaced vertebra upon the lower)⁸:

- First degree <25%
- Second degree 25-50%

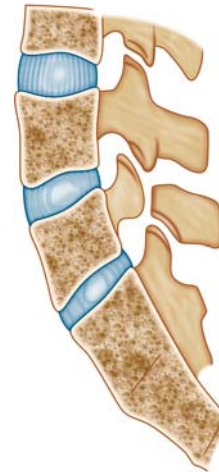


Fig. 1: Spondylolysis: Defect of continuity of the pars interarticularis of the vertebra



Fig. 2: Spondylolisthesis: Slipping of one vertebra over those below it

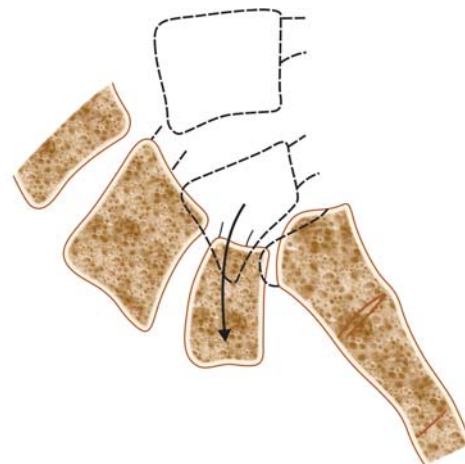


Fig. 3: Spondyloptosis: Slipping and tilting of the L5 from the sacrum

- Third degree 50-75%
- Fourth degree (Wiltse 1983) >75%

CLINICAL SIGNS

Symptoms are usually absent in children, particularly if they do not practice or participate in sport. Discomfort arises at the onset of the adolescent growth spurt. However, the lesion is usually only noticed adventitiously following radiography. Beutler demonstrated spondylolysis in 5% of first grade students on routine screening which showed no abnormal association with back pain on a 45-year follow-up.⁹ However, the athlete usually presents with debilitating pain most often near the growth spurt.¹⁰ There are several reasons why the athletic spondylolysis represents a more concerning entity. During spinal development from the young spine to late adolescence, the lumbar lordosis increases with increasing posterior pressure. Repetitive extension during this period adds additional load to the posterior arch. The 6-year-old with an incidental pars fracture has time to develop multiple compensatory stabilizing mechanisms from the interspinous ligaments and the annulus. Athletic spondylolysis has not had the same compensation. It is during this time that there is a chance to develop a spondylolisthesis. A typical example is an athlete practicing sports like gymnastics, figure skating, football, apparatus gymnastics, who has had months of lumbar pain with insidious onset caused and exacerbated by physical activity (particularly repeated flexion and extension, rotation, or a combination of the lumbar spine), occasionally extending to the gluteus and the thigh. There is not usually a history of serious trauma, although sometimes the onset of symptoms is acute and may coincide with a minor injury.¹¹ Objective examination may be negative in spondylolysis or first or second degree spondylolisthesis; sometimes the only evidence available is tightened hamstrings (present in 80% of symptomatic patients). In more advanced spondylolisthesis, the muscular contracture may prevent full flexion of the thigh on the pelvis, so that patients are walking in small steps with the pelvis rotating at each step. Children run or walk on the tips of their toes with knees semiflexed. Lumbar scoliosis is more often found accompanying spondylolisthesis in women and in cases of severe slippage. It is secondary to muscular spasm and disappears in asymptomatic periods (sciatic scoliosis) or after surgical treatment. Idiopathic structural dorsal or dorsolumbar scoliosis is reported in a third of all cases of spondylolisthesis.¹²

RADIOLOGIC IMAGING

Anteroposterior, lateral and oblique standing projections sometimes augmented by tomograms are used to examine a

spondylolysis. In examining a case of spondylolisthesis, oblique projections are generally necessary only in those cases of first-degree slip¹³ (Fig. 3). Bone scintigraphy is useful in symptomatic patients with negative radiographs to reveal a stress reaction of the pars interarticularis, which cannot be visualized radiographically or when the radiographs show a stress fracture of the isthmus to estimate the age of the injury and classify the activity.¹⁴

MRI imaging is useful and excellent for soft tissue changes and may be very informative of the arch with advanced techniques to view this region.

TREATMENT OF SPONDYLOLYSIS AND SPONDYLOLISTHESIS

Treatment options are very variable and often controversial. In spondylolysis and first degree asymptomatic spondylolisthesis the patient must be informed of the possibility of an evolution of the pathology, although sporting activities need not be missed. Clinical and radiographical checks should be performed every year and exercises to correct muscular imbalance should be prescribed. When a 'silent' spondylolisthesis exceeds the first degree, sport involving a high risk of physical contact and trauma to the back should be forbidden (I am not sure that we can say this as there is little evidence to prohibit nonpainful activity. These should be followed).

Some centers report good success with sports limitation for 4 to 5 months in combination with an antilordotic physical therapy program.

Conservative programs have been highly successful in relieving symptoms and usually allow ongoing athletic participation in conditions, such as spondylolysis or spondylolisthesis. In particular the adolescent-onset spondylolysis stress fracture, even when it has not been successfully immobilized (immobilization is often done with an elastic brace, e.g. Bandage) to the point where healing was occurred, may be a source of intermittent painful episodes and back spasms but does not result in true instability of the lumbar spine. In such cases, lysis of the pars interarticularis may result in a low-grade forward listhesis at the segmental level in question. It is very rare to see a spondylolysis of this type progress to a spondylolisthesis greater than the second degree.¹⁵

The key point of successful management of spondylolysis and spondylolisthesis is developing good core strength and stabilization. Core stabilization is much more than pure strength gain, and in rehab programs we are aiming for strength transfer. It is relatively simple to increase the general strength levels of an individual including the core. However, the success of a core strengthening program depends on how efficiently anybody can utilize the strength gains.¹⁶

It should not be attempt to nonfunctionally isolate the quadratus lumborum, transverse abdominus and multifidi muscles, but it should attempt to target or bias them in a functional manner because the neuromuscular system works in movement patterns and not in an isolated plane.¹⁷

In pain patients especially the concept of underwater therapy offers many possibilities in supporting the coordination of the trunk, arms, legs and thus makes it possible to drill the entire chain of motion (kinetic chain).¹⁸

CORE STRENGTHENING

Spine problems caused by spondylolysis and spondylolisthesis may be naturally multiple and so they request individual therapy management. Some rehabilitation principles are generally valid and correctly used in all injury patterns, while others require individual instruction.

The base of all rehab programs is trunk stabilization. Trunk stabilizing programs may significantly improve strength, but the success of these programs may result from other factors, especially improved neuromuscular control, power and strength balance.

Spine injuries are always causing a change in the movement-pattern and this is influential to the behavior of the patient.

Problems in the spine are marked by following facts:

- Pain
- Disturbances in motion (movement patterns)
- Trophic changes
- Atrophy of the muscles
- Disturbances in coordination and balance.

The therapy medium 'movement', dosed and adapted in the right manner affects all facts listed above in a very positive order. For using movement patterns in therapeutic process all the core muscles must be stabilized.

At present the therapeutic relevance of spine stabilization is discussed by a model that is based on experimentally supported data.

This model is based upon both global and a local spine stabilization of the muscle system. The global muscles (extrinsic) muscles are the multisegmental stabilization system. The local muscles (intrinsic) muscles are the segmental stabilization system. Global muscles are primarily for motion patterns like walking, throwing, jumping, etc. The local muscles are primarily for joint stability and posture.¹⁹

EMG and ultrasound studies show dysfunction of the local muscle system in patients with low back pain and the musculus transversus abdominis and the musculus multifidus greatly influence the local muscle system. The musculus transversus abdominis is essentially involved in the development of the tension tube of the trunk. The

musculus transversus abdominis communicates by the fascia thoracolumbalis with all spinal segments creating tensile support to dorsal side of the tube.²⁰

The musculus multifidus stabilizes the segments and combines with transversus to create a 'transversal girding' of the spinal segments. The girding of the muscles and fascias serve to functional compensate the clinical instability of the spine segments and the stabilized the pathological movement patterns. Recent studies show that in all movement patterns the innervation initiating contraction of the musculus transversus abdominis is earlier than all other muscles and so this is the key-function for the segmental stabilization.

In patients with back pain the innervation of the musculus transversus abdominis is delayed and results in a weaker segmental stabilization.

Experimental data show that both—the diaphragm muscle as the roof and the pelvis as bottom of the core cylinder and also contribute to the 'muscular cylinder—tension tube' for stabilizing the trunk. EMG data are confirm that the innervation of deep and lower parts of the abdominal muscles are directly synchronized with innervation of pelvis bottom and breathing.

The aim effective spine rehabilitation is training for both segmental stabilization and global stabilization.

Modalities for core stabilization are as follows:

- Movements in closed-chain-kinetics
- Renewing of the motion-pattern
- Antilordotic movement patterns of the spine
- Elastic band exercises in lying position
- Gait training
- Brace-gymnastics
- Stretching exercises
- Sensomotoric training on instable devices
- Functional electric stimulation
- Walking in all variations
- Underwater therapy
- Balance training
- Coordinative skills.

These modalities are the base of an effective and functional stabilization training program and lead to:

- Better balance
- Better sensomotoric capability
- Better stabilization capability
- Effective and stabile movement patterns
- Learning and training of functional and sport specific movement patterns requires complexity, diversity and continuity.

CONCLUSION

In spondylolysis and first degree spondylolisthesis conservative treatment with reducing the sport activity for

some months, special antilordotic bracing also for some months and a functional core stabilization training is very effective.

When conservative management has been unsuccessful in controlling symptoms and in cases of spondylolysis or spondylolisthesis in athletes that results in recurrent severe pain and dysfunction and progressive movement of the spinal segments, especially in third and fourth degree cases and very rare in second degree cases, consideration may be given to surgical stabilization with spinal fusion.

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