

SPONDYLOLISTHESIS

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Definition

“Spondylolysis” – defect in pars interarticularis

“Spondylolisthesis” - heterogeneous group of disorders characterized by forward displacement of one vertebra on another

SPONDYLO

meaning spine

LISTHESIS

meaning to slip

HISTORY

1741 Nicholas Andry: hollow back

1782 Herbiniaux Belgian obstetrician

1854 Kilian slow displacement *'Spondylolisthesis'*

1855 Roberts: No slip if arch intact

Grades

- I < 25%
- II 25-50%
- III 50-75%
- IV 75% - complete
- V > 100% (spondyloptosis)

Classification

Wiltse, Newman, and Macnab (1976)) – based on etiology :

Type I Congenital / Dysplastic

Type II Isthmic

Type III Degenerative

Type IV Traumatic

Type V Pathologic

Type VI Post-operative / Iatrogenic

Group	Number of cases	Males	Females
I (Congenital)	66	20	46
II (Spondylolytic)	164	93	71
III (Traumatic)	3	3	0
IV (Degenerative)	80	22	58
V (Pathological)	6	4	2
Total . . .	319	142	177

Type	Name	Description
I	Congenital	Dysplastic abnormalities
II	Isthmic	
	A	Lytic (stress fracture)
	B	Healed fracture (elongated, intact)
	C	Acute high energy fracture
III	Degenerative	Segmental instability
IV	Traumatic	Fracture of hook other than pars
V	Pathologic	Underlying pathology
VI	Iatrogenic	Surgical excision of posterior elements

**Wiltse, Newmann, MacNab
Clin Orthop 1976**

Pathophysiology

Dysplastic pathway

Traumatic pathway

Dysplastic pathway

Body weight transmitted through weak zone

Soft tissue restraints: plastic deformation

Growth plate overloaded

Traumatic pathway

Repetitive cyclic loads (sports)

Stress fracture of a Normal pars

Hard cortical pars predisposes to fatigue fracture and non-union

Predisposes to a vertical subluxation

Congenital / Dysplastic

15-20%

Almost exclusively at L5-S1

Dysplasia of 5th lumbar and sacral arches/facets

Female : male = 2:1

Isthmic (Spondylosis)

Most occur between **11 and 15 years** of age

High-grade slips are four times more likely in **women**

More common

- **white** 50%
- **male** 2:1
- competitive **athletes**
- **familial** incidence – 40%

Natural History

The likelihood of slip progression is low in adults

It most likely occurs in the **child** or **adolescent** with more than 50% slip

Women are at **greater** risk for **progressing** to higher grade slips

- 15 – 70% 1st degree relatives

Albanese JPO 1982

Wynne-Davies JBJS Br 1979

- Lysis commoner in boys
- Slips commoner in girls

Roche JBJS Am 1952

- Eskimos 25% (arch defects)

Stewart JBJS Am 1953

- 15% of persons with a pars lesion
- During the growth spurt
- Minimal change after 16 y
- No pain during progression

Bentley Spine 2003

Risk factors for slip progression in spondylolisthesis (Hensinger 1989)

Clinical

Growth yrs (9 – 15)

Girls > Boys

Back pain

Postural or gait abn

Radiographic

Type 1 (dysplastic)

Vertical sacrum

>50 % slip

Increasing slip angle

Instability on flex/ext views

Back pain

Chronic muscle spasm (protective):

- ‘painful’ pars
- Annular tears
- Root compression / traction

Leg pain is the most common symptom

Moller Spine 2000

Leg pain

L5 compression / traction

Abnormal motion

Facet joint arthrosis

Pars scar

The disc as far-lateral

Sciatica

less common pattern – in 14%

more typical of **dysplastic** spondylolisthesis

causes:

disc prolapse at level above or below

fibrocartilaginous mass at the site of the pars defect itself

“far-out lateral”

Neurological Dysfunction

Paresthesia and Weakness

more common in isthmic spondylolisthesis from L5 root compression

incontinence of bladder and bowel

usually occurs with congenital types

Purpose of imaging

Disc degeneration (MRI / CT)

Facet joint degeneration (MRI / CT)

Pelvic and spinal measures (Erect xrays)

Disc degeneration: MRI

Grade	Structure	Distinction of Nucleus and Anulus	Signal Intensity	Height of Intervertebral Disc
I	Homogeneous, bright white	Clear	Hyperintense, isointense to cerebrospinal fluid	Normal
II	Inhomogeneous with or without horizontal bands	Clear	Hyperintense, isointense to cerebrospinal fluid	Normal
III	Inhomogeneous, gray	Unclear	Intermediate	Normal to slightly decreased
IV	Inhomogeneous, gray to black	Lost	Intermediate to hypointense	Normal to moderately decreased
V	Inhomogeneous, black	Lost	Hypointense	Collapsed disc space



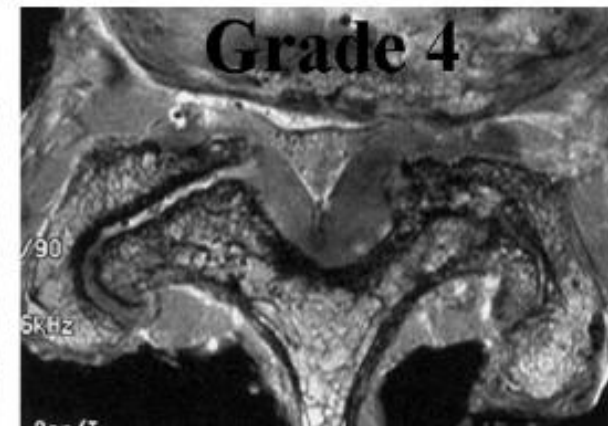
Facet degeneration: osteophytes

1. No osteophytes



2. Small

3. Moderate

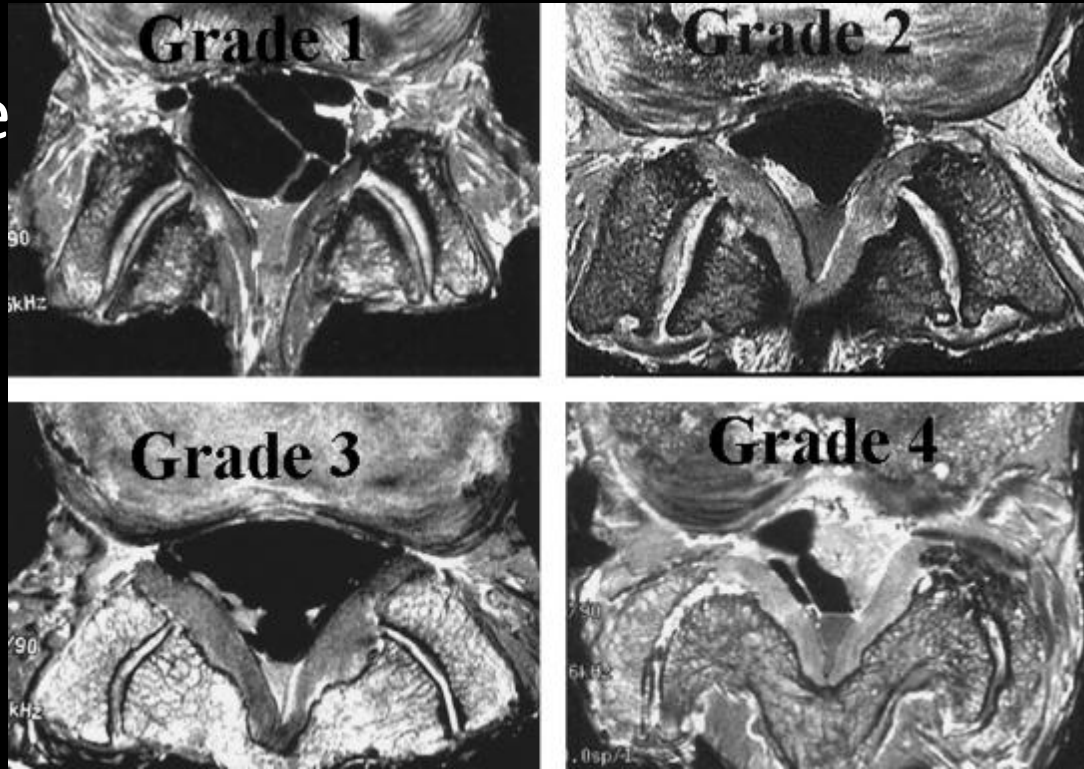


4. Large

Grogan et al AJNR 1997

cartilage

1. Uniformly thick layer
2. Focal erosions
3. Areas of deficiency with exposed bone
4. Cartilage absent except traces



Management: Isthmic Spondylolisthesis

CONSERVATIVE :

-follow-up of young patients with spondylolysis –
spondylolisthesis

- pars defect discovered at **< 10 years**

- XR q4 mths

- then q6 mths to 15 years

- then annually until completion of growth spurt

up to 25%, asymptomatic

- no limitation on activity
- avoid occupation with heavy labour

- up to 50%, asymptomatic

- activity modification
- avoid heavy labour

- up to 50%, symptomatic

- brace

- limited activities, exercises

- > 50%

- consider surgery, esp. if <10 years old

GOAL OF SURGERY

Address the pars defect

Decompress the foraminal stenosis

Address the degenerate disc/s

Address the dynamic instability

Surgical indications

Persistent/recurrent major symptoms for at least one year despite conservative therapy

Progressive neurologic deficit

Progressive slipping beyond 50% even when asymptomatic

High slip angle (40-50°) in a growing child

Tight hamstrings, abnormal gait unrelieved by physical therapy

- levels to fuse:

- in child/young adult, usually do just L5-S1
- in adults, need to consider including L4-5 as well if abnormal

For Grades I, II :

- posterior fusion of L5-S1 using pedicle screws
- do decompression if leg pain

unsatisfactory outcome associated with:

male gender smoking

decompression for radicular symptoms

- 80-90% improvement in symptoms

For Grades III, IV

- controversy about whether to attempt reduction
- probably not d/t high rate of neurological sequelae – 25%
- procedure of choice remains pedicle screw fixation

- other alternatives:
 - PLIF
 - anterior interbody fusion

Complications:

Pseudarthrosis

loss of motion segments

further slippage – in 33%, esp. the slip angle rather than actual displacement

Neurologic deficit

dural tear/CSF leak

Management: Degenerative Spondylolisthesis

CONSERVATIVE

- attempt:

exercise programs

Bracing

NSAID

analgesia

80-85% treated with simple conservative measures

SURGERY

Indications:

- failed conservative management
- neurological deficit

Role of spinal fusion in degenerative spondylolisthesis is less clear

other relative indications:

- patients less than 60-65 years
- physiologically active patients
- large disc height at the slipped level
- good result in 80% of patients

SPORT Trial

**Results for Sx vs Non-Sx treatment for lumbar degen
spondylolisthesis...**

Weinstein et al. NEJM 2007; 356:2257-70

303 Pts in an observational cohort; 304 Pts randomized.

High crossover rates (~40% each direction)

Sx involved decompression +/- fusion

Intention-to-treat analysis showed no significant effects with surgery

As-treated analysis found significant benefit with Sx at 3 months, that increased by 1 yr, and slightly diminished by 2 yrs

The effect of Sx as seen with As-treated analysis was maintained out to 4-yrs f/u (Weinstein et al. JBJS 2009)