CLASSIFICATION

ACTUAL INSTABILITY

POTENTIAL INSTABILITY

OCCULT INSTABILITY OR MICROINSTABILITY
ACTUAL INSTABILITY
Present at the time of clinical observation and demonstrated by functional X-rays (hypermobility)
POTENTIAL INSTABILITY

Not present at the time of clinical observation and not demonstrated by functional radiographs (no hypermobility)

It may become actual if stability of the motion segment is decreased even slightly (discectomy, arthrectomy)
OCCULT INSTABILITY OR MICROINSTABILITY

Not demonstrated by functional radiographs, but indirectly suggested by other imaging studies or by clinical or biomechanical findings.
INSTABILITY

IMAGING &

BIOMECHANICS
MRI criteria of degenerative instability of the lumbar spine

• Tear of the annulus fibrosus
• Modic changes of the subchondral bone
• Increased joint space and joint fluid

• Spondylolisthesis (visible also on X-Rays)
3 TYPES OF TEARS OF THE ANNULUS

Type I       concentric
Type II      radial
Type III     trasverse
RADIAL TEAR

Linear focal hyperintensity of annulus in T2 sequences, with enhancement after gadolinium due to the presence of granulation tissue.
TRANSVERSE TEAR

Post Gd
Intervertebral disk appearance correlated with stiffness of lumbar spinal motion segments

Radial and transverse tears produce a decreased rigidity of the intervertebral disc and an increased mobility of the disc-somatic unit when it is submitted to torsional load

V M Haughton et al. AJNR 1999
82 motion segments of cadavers underwent RMI and torsional load.

**Mean Coefficient of the Disc**

- 7.0 Nm/degree for normal discs
- 3.1 Nm/degree for discs with advanced degeneration
- 1.9 Nm/degree for discs with concentric or transverse tears
- 1.7 Nm/degree for discs with radial tears

**Coefficient of Rigidity**

Ratio of the amount of applied load to resultant motion.
Radial and transverse tears of the annulus, i.e. those of the posterior outermost part of the disc, may be associated to discogenic pain.

Yu et al. AJNR 2002
In 67% of patients with radial tears on RMI discography elicits pain.
MODIC CHANGES

Type I: hypo in T1 and hyper in T2, replacement of yellow marrow with fibrovascular tissue

Type II: hyper in T1 and hyper in T2, chronic change

Type III: hypo in T1 and T2 sclerosis of subcondral bone

Typo I associated to LBP
Toyone et al. JBJS 1994

Unclear association with instability
Bram et al. 2005
INCREASED JOINT SPACE AND FLUID

Mailleux P et al.

Distension of the inter-facet joints in MRI: and indirect sign of an existing underestimation of spondylolisthesis and canal stenosis.


Increased synovial fluid in facet joints on MRI in supine position associated with degenerative spondylolisthesis.
Ortostatismo
Axial loader MIKAI manufacturing
Degenerative spondylolisthesis of L4 after compression
The decrease-redistribution of synovial fluid of facet joints:

Sign of microinstability?

Probably the most interesting observation as regard to the MRI in compression
CONCLUSIONS IMAGING

• Some MRI findings may lead to suspect an instability

• They are the tears of the annulus fibrosus, Modic I changes of subcondral bone and particularly the increase in synovial fluid of facet joints
CLINICAL FEATURES

Low back and/or radicular pain
DEGENERATIVE SPONDYLOLISTHESIS

LOW BACK PAIN

SYMPTOMS

Pain in the prolonged standing position (post office) and improvement in the supine position (frequent)

Pain in prolonged walking (fairly frequent)
Pain in physical efforts (frequent, aspecific)

SIGNS

Pain on flexion-extension of the spine (fairly frequent, aspecific)
Pain on local pressure (frequent, aspecific)
BUT INSTABILITY, EVEN ACTUAL, IS ALWAYS ASSOCIATED WITH LOW BACK PAIN?

NO
Woman, 74 y., chronic LBP. Could not walk more than 100 m. Numerous conservative treatments with no improvement. No radicular pain. Refused surgical treatment.
Functional radiographs
Carried out anaesthetic block of posterior joints at L3-L4, L4-L5, L5-S1 level to determine whether pain was due to vertebral instability or arthrosis of facet joints.

For a few hours, complete disappearance of back pain at rest and on walking.
Carried out percutaneous thermorhyzotomoy of facet joints at the lower 3 lumbar levels with almost complete disappearance of back pain, still after 8 months.
STENOSIS

**SYMPTOMS**

- No symptoms
- Low back pain

**SIGNS**

- Usually no or mild radicular signs
- Rarely severe motor deficits

Low back and radicular pain

- Only or especially radicul. pain
  (unilateral o bilateral)
- Claudicatio intermittens
DIAGNOSIS

- History (++++)
- Clinical signs (+ -)
- Imaging: RMI (+++), CT (++)
- EMG (+ -)
DISCOGENIC INSTABILITY

SYMPTOMS

Continuous LBP or intermittent LBP with acute episodes (frequent, aspecific)
LBP on trunk flexion and torsion (frequent, fairly aspecific)
LBP during heavy physical activity (frequent, aspecific)

SIGNS

Pain on trunk flexion (frequent, aspecific)
Pain on torsion, lateral inclination (frequente)
Pain on local pressure (frequent, aspecific)

NO RADICOLARI SIGNS
MODIC 1

SYMPTOMS

No LBP

Occasional LBP

Intermittent LBP or continuous pain on physical activities (exercises), efforts, trunk flexion (frequent)

SIGNS

Pain on trunk flexion (frequent, aspecific)

Pain on pressure (aspecific)

NO RADICULAR SIGNS
DIAGNOSIS OF CERTAINTY

Usually easy for radicular disturbances

Difficult in the presence of only back pain

Diagnostic tools
Anaesthetic block in spondylolistheis

And in microinstability?
Rigid lumbar corset? But only for levels above L5-S1

Pelvi-condylar plaster cast for L5-S1? But patient does not accept!
CONCLUSIONS 1

There are certain instabilities: **actual instability**

There are probable instabilities: **potential instabilities**

There are possible instabilities, difficult to demonstrate and based on indirect biomechanical, imaging and clinical data: **microinstability**

**Attention**: even the actual instabilities can be simple hypermobilities
CONCLUSIONS 2

The vertebral clinical features are very variables and are mostly aspecific.

The most reliable symptoms are: pain in prolonged standing and walking.

Diagnostic tests may at times be useful.

Microinstability is still a condition that is scarcely known to a large extent.
GRAZIE
Instabilità e rottura anulus

Bram et al., Acta Radio 2005

Analizzati 300 segmenti di moto, di 60 pazienti sottoposti a Rx funzionali e RM.

32 segmenti di moto erano instabili (11%)
6 segmenti (di 600) avevano rottura dell’anulus e tutti erano instabili

rottura anulus:

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<th>sens</th>
<th>spec</th>
<th>VPP</th>
<th>VPN</th>
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<td>18.8%</td>
<td>98%</td>
<td>42.9%</td>
<td>90.9%</td>
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In presenza di rotture anulari si dovrebbero fare RX funzionali
post-gadolinio
INSTABILITA’ POTENZIALE

Non presente al momento dell’osservazione clinica e non dimostrabile con RX funzionali (no ipermobilità).

Può diventare attuale se si riduce la stabilità del segmento di moto (discectomia, arrectomia)
Rottura Anulus

E’ frequente anche negli asintomatici.
Annular tears in 20 di 36 ASINTOMATICI: 56%

in 11 di 18 SINTOMATICI: 61%

• P > .12 non differenza significativa
• maggior frequenza in rapporto all’età
• 75 % iper in T2
• 4% senza enhancement
• 21 % non visibili in T2

Stadnik TW Radiolgy 98’
Uomo di 58 a., dolore lombare cronico, soprattutto in sforzi fisici, non dolore radicolare, numerosi trattamenti conservativi senza successo.

Infiltrazione anestetico a livello della spondilolisi bilateralmente, scomparsa completa del dolore anche in sforzi per 6 ore
ortostatismo

flessione
Instabilità e alterazione tipo Modic
HIZ incidentale

Instabilità e rottura anulus
HIZ, esperienza personale

• In 124 Pz con lombalgia rilevo di HIZ nel 32% (40 Pz.)

• 6 Pz presentavano anche alterazione degenerativa dell’osso subcondrale
White III, Panjabi 1978: The loss of the ability of the spine under physiologic loads to maintain relationships between vertebrae

La perdita di capacità del rachide, sotto carichi fisiologici, di mantenere i rapporti tra le vertebre

Pope, Panjabi 1985: A loss of motion segment stiffness, such that force application to that motion segment produces abnormally great motion compared to that of a normal spine.

Una perdita di rigidità del segmento di moto, tale che la forza applicata a quel segmento produce un movimento abnormemente maggiore che in un rachide normale

Frymoyer, Selby 1985: An abnormal response to applied loads characterized kinematically by abnormal movement in the motion segment beyond normal constraints

Un’ anomala risposta ai carichi applicati caratterizzata cinematicamente da un abnorme movimento nel segmento di moto oltre i normali limiti
CLASSIFICAZIONE

INSTABILITA’ ATTUALE
Presente al momento dell’osservazione del paziente e dimostrabile con Rx funzionali

INSTABILITA’ POTENZIALE
Non presente al momento dell’osservazione del paziente e non dimostrabile con RX funzionali, che può diventare attuale se si riduce chirurgicamente la stabilita’ del segmento di moto (discectomia, artrectomia)

INSTABILITA’ OCCULTA O MICROINSTABILITA’
Non dimostrabile con RX funzionali, ma suggerita indirettamente da altre modalità di imaging o da osservazioni biomeccaniche o cliniche
CLASSIFICAZIONE

INSTABILITA’ ATTUALE
Presente al momento dell’osservazione clinica e dimostrabile con Rx funzionali

INSTABILITA’ POTENZIALE
Non presente al momento dell’osservazione clinica e non dimostrabile con RX funzionali, che può diventare attuale se si riduce stabilità del segmento di moto (discectomia, artrectomia)
CLASSIFICAZIONE

INSTABILITÀ' ATTUALE

INSTABILITÀ' POTENZIALE

INSTABILITÀ' OCCULTA O MICROINSTABILITÀ'
INSTABILITA’
BIOMECCANICA (MATEMATICA-
SPERIMENTALE)
INSTABILITÀ “RADIOLOGICA”
INSTABILITÀ CLINICA

- DIAGNOSI DIRETTA
- DIAGNOSI INDIRETTA
IDENTIFICAZIONE DELLA INSTABILITA’
CLASSIFICAZIONE
TIPI DI PATOLOGIE

- SPONDILO ISTMICA
- SPONDILO DEGENERATIVA
- DISCOPATIA DEGENERATIVA
- SCOLIOSI
QUADRI CLINICI
IMAGING
TRACTION SPUR
A 74-year old woman complained of chronic back pain, which worsened on walking. In the last few months, pain had become more severe and prevent her walking more than 100 metres. She had no leg pain.

She had undergone several conservative treatments (anti-inflammatory medication, physical therapy and mild exercises) with no significant improvement.
Anteroposterior and lateral plain radiographs
Flexion-extension radiographs
WHAT TO DO ?

1. Insist with the conservative treatment ?

2. Interspinous stabilization with Aspen or Wallis ?

3. Pedicle screw instrumentation and fusion at the lower 3 lumbar levels ? (the patient did like to undergo a heavy operation)
We carried out an injection of a local anaesthetic at L5-S1, L4-L5 and L3-L4 on both sides to determine whether low back pain was due to vertebral instability or arthrotic changes of the facet joints.

For a few hours after the injection the patient had a complete disappearance of back pain also on prolonged walking.
Percutaneous rizothomy of the lower 3 facet joints on both sides was performed with almost complete disappearance of back pain, still at 8-month follow-up.