Lumbar Minimally Invasive Surgery: Interspinous Devices in degenerative disc disease

Carlo Doria MD PhD
Symptomatic Degenerative Disc Disease (DDD) is a frequent indication for lumbar spinal surgery in the middle-age population.
Degenerative Cascade

- Disc degeneration
- Bulging of the annulus
- Facet joint hypertrophy
- Thickening of the ligamentum flavum

Contribute to narrowing of the spinal canal and/or lateral foraminal recesses

radicular pain

A higher incidence in peri and post menopausal women has been noted
Symptoms are typically exacerbated on extension of the spine, e.g. on standing or walking when the canal is further narrowed, and alleviated on flexion.


Baastrup Disease

Chung Cl. : Le “lumbago” et les affections radiologiques des apophyses épineuses des vertèbres lombaires; de la I vertèbre sacrée et des parties interépineuses. J Radiol Electrol 1936; 20:78-93

Facet Joint Syndrome
Baastrup Disease

Facet Joint Syndrome

Chronic Low Back Pain
Which way ????

Failure of conservative treatment (drugs, physiotherapy and epidural injection)

SURGERY

- Microsurgical decompression / Fusion
- Disc Arthroplasty (DDD alone without LSS)
- Arthrorisis
  - Interspinous spacers
  - Dynamic Pedicle Screw Fixation
  - PercuDyn System
Currently, motion preservation and dynamic stabilization also are rapidly developing in spinal surgery. Devices for these treatments include a variety of new implant technologies developed to preserve, limit or enhance motion of the spine.

- Posterior dynamic stabilization systems
- Nucleus replacement devices
- Total Disc Replacement
- Interspinous devices
The interspinous device does not replace microsurgical decompression in patients with massive stenosis and continuous claudication, but offer a save, effective and less invasive alternative in selected patients with moderate “soft” spinal stenosis and symptomatic DDD.

**Rationale**
- Unload the facet joints
- Restore foraminal height
- Provide stability (extension)
- Retention of posterior annulus
- Stretch the ligamentum flavum
- Disc regeneration

DIAGNOSIS for correct indications

Clinical
- The most important inclusion criterium was a reproducible alleviation of symptoms (leg pain and lumbago) on flexion and exacerbation of symptoms in extension of the lumbar spine (Positional Claudication)

Radiological
- Dynamic X-rays (max flexion and extension)
- CT scan 3-D reformatted for study of neuroforamina
- Functional (Upright) MRI examinations were able to demonstrate the positional-dependent stenosis

Pre-op extension | Post-op extension | Pre-op flexion | Post-op flexion
Dynamic lumbar Stabilization with interspinous implants: the history

1986
The first interspinous device in Europe

Titanium → PEEK
PEEK ADVANTAGES

* Biocompatibility
* Biostability
* Compatibility with diagnostic imaging
* More elastic than titanium (reduce the risk of spinous process stress fractures)
CLINICAL ADVANTAGES

* Increases stiffness to the treated segment relieving low back pain due to degenerative diseases
* Maintains physiological lordosis
* Limits but does not eliminate movement in the treated segment (extension)
* Limits the “domino effect” of degenerative disc disease so called “junctional disease” observed after fusion procedures
* Local anaesthetia
INDICATIONS

Low-back pain that accompanies degenerative lesions of grades II, II and IV (Pfirmann Classification) in lumbar segments primarily in young, active adults in the following indications:

* “Soft” central or lateral stenosis
* Massive herniated disc
* Recurrent herniated disc
* Degenerative disc diseases at a segment adjacent to fusion
* Symptomatic Modic I degenerative changes
CONTRAINDICATIONS

* Grade V degenerative lesions in the MRI classification of Pfirrmann
* Osteoporosis
* Spondylolisthesis
* Spinous process insufficiency
* Non-specific low back pain
* Infection
• Over-sized of implant with over-distraction and relative segmental kyphosis

PITFALLS

• Placement too posterior of implant with possible damage of supraspinous ligament and dislodgement
SURGICAL TECHNIQUE - 1

- Patient under general anaesthesia or local anaesthesia combined with mild sedation
- Prone position on radiolucent table
- A midline skin incision of 5 cm on the spinous processes of the manipulated level (C-arm fluoroscopy)
- The supraspinous ligament is preserved

- The paraspinal muscles were elevated from one side of the spinous processes (right side) to the level of the facets and laminae
The small dilator is introduced parallel to the vertebral spine with the tip in the cranial direction on the right side of the spinous process and advanced through the interspinous ligament from right to left to create a 1-5 mm pilot hole or perforation.

The perforation in the interspinous space should be as anterior as possible to minimise the risk of dislodgement of device.

The dilator is removed and the tips of the sizing distractor are introduced to the pilot hole from the right side. A cycle of tension and relaxation should be repeated two or three times.
Once the spacer is mounted on the dedicated introducer it is positioned to the right side of the spinous process. Once the spacer is placed through the interspinous ligament, it is need to proceed to its final housing by opening the wings into the left paravertebral side (self-deploying) anchoring itself.
OUR EXPERIENCE
2004-2010 : 196 devices in 132 adult patients

SINGLE LEVEL
* L3-L4: 46 cases
* L4-L5: 77 cases
* L5-S1: 9 cases

DOUBLE LEVELS
* L3-L4 and L4-L5: 45 cases
* L4-L5 and L5-S1: 13 cases

THREE LEVELS
* L2-L3, L3-L4 and L4-L5: 4 cases
* L3-L4, L4-L5 and L5-S1: 2 cases

- Mean Age: 54 yrs (range 33-78)
- Ratio male /female: 107/89
Pre-operative diagnosis

- "SOFT" LUMBAR SPINAL STENOSIS
  * central: 34 cases
  * lateral: 41 cases
- DISC HERNIATION: 11 cases
- RECURRENT DISC HERNIATION: 4 cases
- SYMPTOMATIC DEGENERATIVE DISC DISEASE: 35 cases
- FACET JOINT SYNDROME (anaesthetic block): 4 cases
- DISLODGELEMENT OF DEVICE: 2 cases
- POST-SURGICAL SYNOVIAL CYST: 1 case
Clinical Assessment

Patients were clinically evaluated regularly before surgery and during a follow-up period of 18 months using the Visual Analogue Scale (VAS) (0-10 points) and the Oswestry Disability Index (ODI)

Pre-operative average VAS: 7.3 (range 5.2-8.7)
Pre-operative average ODI: 40.3 (range 32.6-48.7)
Radiographic analysis

Dynamic and static radiographs were obtained before surgery and post-surgery at 1, 6 and 18 months

Functional (Upright) MRI examen is for us a DREAM ........

Intervertebral disc height (a)
(measured from endplate to endplate on AP Ferguson and LL X-rays (pre and post-operative)

Interspinous distance (b)
in standing position was also measured
Post-operative MRI was performed in some selected cases:

**MULTILEVEL DEVICES (3 LEVELS)**

**COMPLICATIONS/REOPERATIONS (2 CASES)**
Clinical Results

The VAS decreased at 3.1 (range 2.0-4.2) on post-operative period with highly significant ($P < 0.005$). This effect remained remarkably stable throughout the follow-up period of 18 months.
Clinical Results

Mean ODI score at 1 month post-operative was 21.5, mean ODI score at 12 months postoperative was 15.3 and mean ODI score at 18 months post-operative was 12.4
Clinical Results

In our experience there were no significant differences in post-operative VAS and ODI score related to pre-operative diagnosis.

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Pre-operative VAS</th>
<th>Pre-operative ODI</th>
<th>Post-operative VAS</th>
<th>Post-operative ODI</th>
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<td>Central stenosis</td>
<td>7.1</td>
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<td>Lateral stenosis</td>
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<td>Disc herniation</td>
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<td>Recurrent disc herniation</td>
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<td>48.7</td>
<td>2.9</td>
<td>15.4</td>
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<td><strong>Degenerative Disc Disease</strong></td>
<td><strong>7.3</strong></td>
<td><strong>44.1</strong></td>
<td><strong>2.0</strong></td>
<td><strong>17.4</strong></td>
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<td>Facet Joint Syndrome</td>
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<td>41.2</td>
<td>2.9</td>
<td>16.8</td>
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<td>Dislodgement of device</td>
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<td>43.8</td>
<td>2.5</td>
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<tr>
<td>Post-surgical synovial cyst</td>
<td>6.7</td>
<td>40.5</td>
<td>2.6</td>
<td>14.7</td>
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Radiological Results

The mean posterior disc height measured on AP and LL x-rays was 9.8 ± 2.1 mm pre-operatively and 10.4 ± 2.3 mm post-operatively. Retension of posterior annulus and reopening of neuroforamina.

The post-operative Interspinous Distance increased a mean of 12% respectively to pre-operative data (0.9 cm pre-op versus 1.3 cm post-op) with unloading of facet joints.
Low back pain is usually aggravated by extension and relieved by flexion.

Interspinous devices relieves intradiscal pressure and widen the neural foramen.

Adequate positioning of device requires a deep insertion at the base of spinous process.

Discussion

Interspinous devices

A morphometric study of the lumbar foramen
Influence of flexion-extension movements and of isolated disc collapse

MA Mayoux-Benhamou, M Revel, C Aaron, G Chomette and B Amor
Interspinous device have common mechanical actions such as distraction between adjacent spinous processes and restriction of extension achieving posterior neural decompression.

Minimally invasive technique: unilateral surgical approach and ligament preserving.

Simple procedure with a short "learning curve"
Risk factors for failure

- Female (poor muscle tone abdominal wall and paravertebral muscles)
- Hyperlordosis with high obliquity of spinous process
- Hypoplasia of spinous process (S1)
- Insufficiency of supraspinous ligament *
- Overweight

“The so called suprasinous ligament in the lumbar spine is not a true ligament, but is a dissection artifact mainly formed by decussation across the midline of the fibres of the right and left lumbosacral fascia”

Interspinous devices is a handy and minimally invasive device but outcomes are strictly related to correct indications and its use must be reserved in select patients with positional claudication in absence of classic contraindications as severe stenosis that require wide decompression.
THANKS