Lumbar Facet Joint Replacement

Prof. Dr. Karin Büttner-Janzen

Past President
International Society for the Advancement of Spine Surgery

Director of Orthopaedic Clinic
Vivantes Hospital im Friedrichshain
+49 30 130 23 1306

Director of Traumatologic and Orthopaedic Clinic
Vivantes Hospital Am Urban
+49 30 130 22 6201

Vivantes Hospital Company, Berlin – Germany

karin.buettner-janz@vivantes.de
Motion Retaining Devices for:
Repair, Preservation or Improvement of Function - including Motion of the Cervical and Lumbar Functional Spinal Unit

- Lumbar Total Disc Replacement
- Cervical Total Disc Replacement
- Nucleus Replacement
- Posterior Dynamic Stabilisation / Screws + Connectors
- Posterior Dynamic Stabilisation / Facet Joint Replacement
- Posterior Dynamic Stabilisation / Interspinous Implants
- Implant Combination
1. Basics of Lumbar Facet Joints

2. Classification of Facet Joint Replacement

3. Clinical Results

4. Facet Joint Replacement (FJR) after Total Disc Replacement (TDR)
Anatomy and Biomechanics

Spinal Motion Segment
[= Functional Spinal Unit]
- 1 Disc
- 2 Facet Joints

“Three-Joint-Complex”
Location based Facet Joint Function

Cervical Spine:
- Lowest transmitted loads of the spine
- Most freedom in lateral bending, extension and axial rotation

Lumbar Spine:
- Facets are larger, more centrally located, and almost parallel along the sagittal plane
- Lateral bending is limited
- Stop for hyper-extension and axial rotation

Variation in facet orientation and location within vertebral regions
(White and Panjabi, Clinical Biomechanics of the Spine, 2nd Ed.)
Facet Morphology

Facet Angle

Facet Curvature
• **Grade I**: uniformly thick cartilage covers the articular surfaces completely.

• **Grade II**: cartilage covers the entire surface of the articular process but an eroded irregular region is evident.

• **Grade III**: cartilage incompletely covers the articular surfaces with regions of underlying bone exposed to the joint.

• **Grade IV**: cartilage is absent except for traces on the articular process.


AGENDA

1. Basics of Lumbar Facet Joints

2. Classification of Facet Joint Replacement

3. Clinical Results

3. FJR after TDR
### Classification of Facet Joint Replacement according to
- **Design**
- **Material**

  (further developed to Büttner-Janz, 2008; In: Motion Preservation Surgery of the Spine)

1. **Facet Resurfacing / Partial Facet Joint Replacement**
   - a) Plastic
   - b) Metal
   - c) Combination of metal and plastic

2. **Total Facet Joint Replacement**
   - a) Plastic
   - b) Metal
   - c) Combination of metal and plastic

3. **Three Joint Replacement**
   - (Facet Joint Replacement + Disc Replacement at same segment + time)
     - a) Combination with Nucleus Replacement
     - b) Combination with Total Disc Replacement
       (implantation via ventral, lateral or dorsal approach)
**Examples**

Classification of Facet Joint Replacement according to
- Design
- Material

(further developed to Büttner-Janz, 2008 - In: Motion Preservation Surgery of the Spine)

<table>
<thead>
<tr>
<th>1.</th>
<th><strong>Facet Resurfacing / Partial Facet Joint Replacement</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>→ Does not violate the pedicles = Minimal invasive surge</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>a) Plastic</th>
</tr>
</thead>
<tbody>
<tr>
<td>b) Metal</td>
<td></td>
</tr>
<tr>
<td>c) Combination of metal and plastic</td>
<td></td>
</tr>
</tbody>
</table>

- ZYRE Facet Implant System
- FENIX Resurfacing System
- Zyga GLYDER Device
### Examples

Classification of Facet Joint Replacement according to:
- Design
- Material

(further developed to Büttner-Janz, 2008; In: Motion Preservation Surgery of the Spine)

### 2. Total Facet Joint Replacement

→ Violates the pedicles, vertebrae, laminae, muscles and ligaments
  = Maximale invasive surgery

<table>
<thead>
<tr>
<th>a) Plastic</th>
<th>b) Metal</th>
<th>c) Combination of metal and plastic</th>
</tr>
</thead>
</table>

TFAS  | TFAS-LS  | ACADIA Facet Replacement System |

TOPS System
TOP SP System is 30% smaller device. Not yet implanted in human.
Examples
Classification of Facet Joint Replacement according to:
- Design
- Material

(further developed to Büttner-Janz, 2008; In: Motion Preservation Surgery of the Spine)

<table>
<thead>
<tr>
<th>2. Total Facet Joint Replacement</th>
</tr>
</thead>
<tbody>
<tr>
<td>→ Violates the pedicles, vertebrae, laminae, muscles and ligaments!</td>
</tr>
<tr>
<td>= Maximale invasive surgery</td>
</tr>
<tr>
<td>a) Plastic</td>
</tr>
<tr>
<td>b) Metal</td>
</tr>
<tr>
<td>c) Combination of metal and plastic</td>
</tr>
</tbody>
</table>

IN VITRO:
**Auxiliary Facet System (AFC)**
Yann Philippe Charles et al.:
SPINE 2011 Volume 36, Number 9, pp 690–699
(2 angulated rods, polyaxial connectors, crosslink, 4 pedicel screws – all metal components)
### Examples

Classification of Facet Joint Replacement according to:
- Design and
- Material

(further developed to Büttner-Janz, 2008; In: Motion Preservation Surgery of the Spine)

<table>
<thead>
<tr>
<th>3. Three Joint Replacement</th>
<th>(Facet Joint Replacement + Disc Replacement at same segment + time)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>→ Violates the disc, pedicles, vertebrae, laminae, muscles, ligaments!</td>
</tr>
<tr>
<td></td>
<td>= „Most maximale“ invasive surgery</td>
</tr>
</tbody>
</table>

**a) Combination with Nucleus Replacement**

**b) Combination with partial oder Total Disc Replacement**

(disc implantation via ventral, lateral or dorsal approach)
1. Basics of Lumbar Facet Joints

2. Classification of Facet Joint Replacement

3. Clinical Results

3. FJR after TDR
Facet Recurfacing:

- Painful Degeneration of Facet Joint (after Denervation)
- Post TDR Facet Joint Disease
- Inflammation of Facet Joint
- Cyst of Facet Joint
- “Facet Kicking Syndrome” (after Fusion, TDR - L.Pimenta)
- (Degenerative Spondylolisthesis)
Zyre Facet Implant System (2007)
With / without bone resection.
Lauryssen et al. 2008: Minimal-invasiv surgery as stand alone
device or in combination with other motion retaining devises.
No clinical data available

FENIX Resurfacing System (2007)
vander Kelft 2009: 8 patients, mean age 53 y
After 1 year 6 patients satisfied, still motion at operated level.
ODI 48 preop. \(\rightarrow\) 18 postop., VAS 7.2 preop. \(\rightarrow\) 2.5 postop.
1 case with spinal canal revision surgery at upper adjacent level
1-2011: 15 patients operated, 2-years follow up, CE-approval
Zyga GLYDER Device (2010)

Surgical Goals:
• Reduced pain or pain-free facet joint
• Maintains natural facet joint motion
• Maintains native anatomy
• Maintains option for Total Facet Joint Replacement
• Maintains option for fusion surgery

- PEEK polymer with Platinum / Iridium Marker
- Teeth on backside to prevent dislocation
- Small size: 9 x 11 mm (L12 and L23)
- Large size: 12 x 14 mm (L3-S1)

→ Not yet CE approved

L. Pimenta/Brasilia
Zyga GLYDER Device

Results of Luiz Pimenta:

- **18 patients** (mean age 44 years)
  - post TDR facet joint disease
  - facet joint degeneration/disease
  - kicking facet syndrome (after fusion)

- Indication: Pain- at preop facet injection
- Incl. double level cases
- Surgical duration ≈ 98 min
- Follow-up ≈ 6 months
Zyga GLYDER Device

→ Hans Jörg Meisel/Germany:
  • 3 patients

Surgery Dec 1st 2011
Zyga GLYDER Device
Total Facet Joint Replacement:

- Symptomatic Spinal Canal Stenosis with indication for facet joint removal
TOPS (2004)
5-year follow up’s available with successful results. After adaptation to smaller implant further surgeries are planned. Company was re-bought.
TFAS (2005)
Not any more on market.
Company was bought by another company.

ACADIA (2005)
Since 2009 US Pivotal Study.
Castellvi (2009): 106 patients, mean age 60 years (34-82):
After 12 postop months ODI improved 79%,
back pain 53%, leg pain 67%.
No re-operation, no implant problem.
Company was bought by another company.
Stem fracture after total facet replacement in the lumbar spine: a report of two cases and review of the literature

Daniel K. Palmer, BS, Serkan Inceoglu, PhD, Wayne K. Cheng, MD

The Spine Journal 11 (2011) e15–e19

Case 1: A 55-year-old man with a body mass index (BMI) of 40 underwent total facet replacement at L4–L5 for Grade 1 spondylolisthesis with stenosis. After 9 months of pain relief, he experienced gradually increasing pain and radiographs showed a broken stem.

Case 2: A 60-year-old woman with a BMI of 31 underwent total facet replacement at L4–L5 for Grade 1 spondylolisthesis with stenosis. She experienced stem fracture 27 months postoperatively.

Treatment: Trans-psoas interbody fusion surgery
Indications

→ “Three Joint Replacement”:

• Includes indications of TDR + FJR
Inlign Total Motion Segment (2008)
Study with 50 patients was started.
Results are unknown.
1. Basics of Lumbar Facet Joints

2. Classification of Facet Joint Replacement

3. Clinical Results

3. FJR after TDR
TDR: **Facet Joint Degeneration**

Kube et al. SAS 2006:
→ Outcome in lumbar disc arthroplasty is related to grade of facet arthropathy.

Chan Shik Shim et al. SPINE 2007:
- 57 patients >3 years follow up (MRI: 52 patients)
- Charité 33, Prodisc 24
- Both groups with facet joint degeneration

Park et al. SPINE 2008:
- Prodisc 46 patients min. 2 years follow up
- MRI and CT preop and 2 years F/U: 29.3% progressive facet degeneration

Siepe et al. SPINE 2010:
- Prodisc 93 patients min. 2 years follow up (Ø 53.4 months)
- X-ray and MRI preop and postop F/U: 20.0% facet joint degeneration (FJD)
- FJD more often at level L5/S1; FJD associated with negative clinical outcome and lower ROM
2 years after Charité Artificial Disc:
**TFAS LS cementless**
(Implantation 09-2008)

Excising of complete pain generator

**TDR + Replacement of Facet Joints**

Alternatively:
**Zyga GLYDER Device**
Compact total disc: → Less facet joint degeneration / disease?
→ No adjacent level disease?

SL, f: Nucleotomy: 33 years; Charité disc: 34 years; Freedom disc: 38 years

CHARITÉ + FREEDOM
1. From clinical point of view the „pain generator“ facet joint is as important as the intervertebral disc. From anatomical and biomechanical point of view the lumbar facet joints are to replace. Therefore, carefully diagnostics is needed before surgery.

2. Surgery: Only a few devices are on market. While the main indication for total facet joint replacement is a symptomatic spinal canal stenosis, the single facet joint disease could be the main indication for facet recurfacing. At time of device implantation thinking on potential revision surgery.

3. Spherical ball and socket type of total discs includes the danger for facet joint degeneration and disease. Question: Is there an indication for facet recurfacing preoperatively or postoperatively?

4. Future: At least mid term clinical studies are needed of facet recurfacing and total facet joint replacement.
Thank you!