Lumbar discal herniation as occupational disease in Germany

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Outline

- Introduction: Work-related MSDs in Germany
- Lumbar discal herniation as occupational disease (OD) in Germany
  - History and definitions
  - Pathomechanism and epidemiology
  - Exposure and medical criteria
  - General criteria for acceptance
- Practical issues
  - Anamnesis software/data bases
  - Research activities: situational lumbar loads, job/task exposures and dose-response relationship
Work-related MSDs in Germany

• Approx. 23.3 % of all sick leave due to MSDs*
• Approx. 26 000 new invalidity pensions due to MSDs*
• Costs of loss of production -caused by MSDs - are estimated to be 9.1 Bn €/a*

→ MSD prevention is one of the OSH objectives in the „Common German Occupational Safety and Health Strategy“ – „GDA“

→ DGUV prevention campaign on MSD in 2013

*German OSH Report 2010

MSDs as occupational diseases in Germany

• Upper limb:
  • Diseases due to overstraining tendon sheaths, peritendineum or muscular and tendonous insertions (2101)
  • Osteoarticular diseases of the hands and wrists caused by mechanical vibration (2103)
  • Carpal Tunnel Syndrome CTS (21XX)
• Spine:
  • Intervertebral disc-based diseases of the lumbar or cervical spine (2108, 2109, 2110)
• Lower limb:
  • Meniscus lesions (2102)
  • Knee osteoarthritis (2112)
Degenerative lumbar discal diseases as occupational disease (OD) in Germany

History
before re-unification of the 2 parts of Germany:

Federal Republic of Germany [West]:
no "occupational disease" regarding spine / physical exposure

German Democratic Republic [East]:
OD "Degenerative diseases of the spine caused by mechanical overload for many years ..."

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Degenerative lumbar discal diseases as occupational disease (OD) in Germany

Occupational disease OD 2108

1993: Introduction of OD 2108

„Intervertebral disc related diseases of the lumbar spine
caused by lifting or carrying of heavy loads for many years or
caused by work-related activities in extremely trunk-flexed postures for many years…“
**Degenerative lumbar discal diseases as occupational disease (OD) in Germany**

**Occupational disease OD 2110**

1993: Introduction of OD 2110

„Intervertebral disc related diseases of the lumbar spine caused by whole-body vibrations (mainly vertical vibrations in sedentary postures) for many years …“

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**Pathomechanism – OD enactment**

**Lumbar discal diseases as OD in Germany**

- Nutrition of intervertebral discs:
  - Diffusion process can be affected by long-term mechanical load exposures and/or exertions to whole-body vibrations
  - Possible disturbances of metabolism

- Intervertebral disc compression forces:
  - Manual material handling activities and/or working in awkward postures lead to high lumbar disc compression forces that may lead to irreversible damage of discal tissue
Epidemiology – OD enactment
Lumbar discal diseases as OD in Germany

• Health care studies, e. g.

  Videman et al. 1984  nursing aides vs. qualified nurses
  RR 2.8: chronic LBP
  RR 1.6: sick leave due to LBP
  RR 1.7: bed rest due to LBP
  RR 4.5: disability pension due to degenerative lumbar discal disease
  Exposure: Lifting 4.8 vs. 1.8 h / week
  Trunk bending/rotation 11.9 vs. 3.7 h / week

  Hofmann et al. 1995  sick nursing / elderly care vs. controls
  OR 3.4: disc herniation / -protrusion
  average exposure time: 19.3 + 11.8 yrs.

Epidemiology
Lumbar discal diseases as OD in Germany

• Studies in the construction sector, e. g.

  Riihimäki 1985, ~ et al. 1989  concrete reinforcement workers vs. house painters
  RR 1.5: Wirbelkörper-„Randzacken“ (spondylosis)
  RR 1.8: disc narrowing (chondrosis)
  RR 1.9: end-plate sclerosis (osteochondrosis)
  Exposure  Lifting >20kg: 5/h; 5-20kg: 13/h
  Wickström et al. 1985  Carrying for 2 of 3 liftings
  trunk bent: >90°(12%); 15-90°(18%)
  bent+twist: >90° (2%); 15-90° (3%)
  average concrete reinforcement work: 14.6 + 6.4 yrs.
  exposure + other construction work: 4.2 yrs.
  time + agricultural work: 4.2 yrs.
Epidemiology
Lumbar discal herniation as OD in Germany

- Studies in trade and logistic sectors, e.g.
  - harbour
    Lawrence 1955  dockers vs. office workers
    RR 6.2: moderate / severe radiological lumbar changes
    exposure time: ≥ 11 years
  - Mach et al. 1976  port handling workers vs. white collar workers
    RR 2.0: degenerative spinal changes
    average exposure duration: 6.2 years

Exposure criteria – OD enactment
OD 2108

- Risk assessment for load weights (kg) and action forces (N)

<table>
<thead>
<tr>
<th>Task</th>
<th>female</th>
<th>male</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bi-manual lifting</td>
<td>10 kg</td>
<td>15 kg</td>
</tr>
<tr>
<td>Lifting with one hand</td>
<td>5 kg</td>
<td>10 kg</td>
</tr>
<tr>
<td>Bi-manual load transfer (ideal posture)</td>
<td>20 kg</td>
<td>30 kg</td>
</tr>
<tr>
<td>Load transfer with one hand (ideal posture)</td>
<td>5 kg</td>
<td>10 kg</td>
</tr>
<tr>
<td>Bi-manual carrying besides the body, on the shoulders or back</td>
<td>20 kg</td>
<td>30 kg</td>
</tr>
<tr>
<td>Onesided carrying</td>
<td>15 kg</td>
<td>25 kg</td>
</tr>
<tr>
<td>Pulling</td>
<td>250 N</td>
<td>350 N</td>
</tr>
<tr>
<td>Pushing</td>
<td>300 N</td>
<td>450 N</td>
</tr>
</tbody>
</table>

- Regularly manual material handling per workshift, e.g. 250 lifting or transfer activities or 30 minutes carrying tasks per workday, consideration of postures!
- Or: Working in awkward trunk bending postures for relevant durations
- Exposure exertion for many years, e.g. 10 years with more than 60 shifts per year
Affected tasks and exposures
Lumbar discal diseases as OD in Germany

Exposure criteria
OD 2108

- Application of dose models, e.g., "MDD model", presentation of Matthias Jäger

\[ D = \sqrt{\frac{\sum (F_i^2 \times t_i)}{8h}} \times 8\text{h} \]

<table>
<thead>
<tr>
<th></th>
<th>Männer</th>
<th>Frauen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bandscheiben-Druckkraft</td>
<td>$3.2 \times 10^3$ N</td>
<td>$2.5 \times 10^3$ N</td>
</tr>
<tr>
<td>Tagesdosis</td>
<td>$5.5 \times 10^3$ Nh</td>
<td>$3.5 \times 10^3$ Nh</td>
</tr>
<tr>
<td>Gesamtdosis</td>
<td>$25 \times 10^6$ Nh</td>
<td>$17 \times 10^6$ Nh</td>
</tr>
</tbody>
</table>
**Occupational Disease 2110 (WBV)**

Dose-response relationship – Step 1: daily exposure $A_l(8)$

$$A_l(8) = k_i \sqrt{\frac{1}{8h} \sum_i a_{w_l,i}^2 T_i}$$

- energy-equivalent average
- $l={x,y,z}$ Vibrational direction (predominantly z)
- $k_x=k_y=1.4 \quad k_z=1.0$ constant (sensitivity towards sinusoidal vibration)
- $a_{w_l}$ frequency-weighted acceleration
- $T$ daily exposure time
- $i$ exposure

Take $A_z(8)$ (or largest $A_l(8)$) and count all days with $A_l(8) > 0.63 \text{ ms}^{-2}$

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**Occupational Disease 2110 (WBV)**

Dose-response relationship – Step 2: lifetime exposure $D$

Take $A_z(8)$ (or largest $A_l(8)$) and count all days with $A_l(8) > 0.63 \text{ ms}^{-2}$

$$D = \sum_j A_j^2(8) \quad D_{\text{Limit}} = 1450 \left( \frac{\text{m}}{\text{s}^2} \right)^2$$

- Limit exposure $D_{\text{Limit}}$ from Rheinbraun-Study, whole-body vibration study of DGUV
- Outcome low-back pain as lowest level for occ. diseases 2110 (chondrosis, herniation ...). The largest $A_l(8)$ is relevant.

Medical criteria
Lumbar discal diseases as OD in Germany

- e. g. lumbar discal herniation and/or protrusion, with sensitive and/or motor radix syndrom or with local lumbar syndrom

- Medical history/anamnesis
- Diagnosis of lumbar disc herniation has to be confirmed by CT or MRI
- Chronic recurrent complaints and functional impairments, atypical age-related diagnosis
- Consistency of clinical and radiological findings
- Disease is not therapeutically curable, respective working tasks have to be discontinued
- Consideration of competing factors, e. g. scoliosis, Bektherev’s disease

Medical criteria
Lumbar discal diseases as OD in Germany

- Severe disc narrowing (more than one third compared with adjacent unchanged discs) with sensitive and/or motor radix syndrom or with local lumbar syndrom

- Medical history/anamnesis
- Diagnosis of lumbar disc herniation has to be confirmed by CT
- Chronic recurrent complaints and functional impairments, atypical age-related diagnosis
- Consistency of clinical and radiological findings
- Disease is not therapeutically curable, respective working tasks have to be discontinued
- Consideration of competing factors, e. g. scoliosis, Bektherev’s disease
Medical criteria
Lumbar discal diseases as OD in Germany

- Results of German consensus group of the DGUV

<table>
<thead>
<tr>
<th>Consensus recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bolm-Audorf U. et al. (2005) Medical evaluation criteria for occupational diseases of the lumbar spine related to the intervertebral disc (Part 1+2). Consensus recommendations for assessing the interrelationship as proposed by the interdisciplinary working group established by HVBG/DGUV.</td>
</tr>
</tbody>
</table>

Medical evaluation criteria for occupational diseases of the lumbar spine related to the intervertebral disc

Consensus recommendations for assessing the interrelationship as proposed by the interdisciplinary working group established by HVBG/DGUV.

- New pensions rate: approx. 4.6 % (2010)
- General acceptance rate: approx. 6.6 % (2010)
Occupational Disease 2110 - Statistics

- New pensions rate: approx. 2 - 4 %
- General acceptance rate higher

General criteria
Lumbar discal herniation as OD in Germany

- Constraint for job termination (exception: ergonomic work design to reduce workloads)
- Compensation claims dependant on degree of disability:

<table>
<thead>
<tr>
<th>Category</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduction in physical capacity</td>
<td>low</td>
<td>medium</td>
<td>high</td>
<td>very high</td>
</tr>
<tr>
<td>Reduction in earning capacity acc. to diagnosis</td>
<td>10 %</td>
<td>20 %</td>
<td>30-40 %</td>
<td>≥50 %</td>
</tr>
<tr>
<td>Functional reduction regarding workload</td>
<td>Frequent: working in trunk-flexed postures, manipulating heavy objects, high loading due to WBV</td>
<td>Long-term constrained sedenatary or standing postures, More than occasional: working in trunk-flexed postures, manipulating heavy objects</td>
<td>Occasional: working in trunk-flexed postures, manipulating heavy objects</td>
<td>Extensive limitations regarding: materials handling, walking, standing, working in trunk-flexed postures, kneeling, crouching, working overhead, sedantary work, WBV</td>
</tr>
</tbody>
</table>
The OMEGA-Database-System

- Anamnesis software OD 2108 and OD 2110

OMEGA

- Hazardous substances
- Noise
- Vibrations
- Musculoskeletal load

Anamnesis software OD 2108

- Standardized exposure documentation
- Use of registers/ data bases to reconstruct exposures of workshifts and whole working lifes
- Integrated dose model
- Link to other anamnesis software, e.g. OD 2110
Anamnesis software OD 2108

Modular structure

- Occupational history
- Phases of employment
- Typical workshifts
  - Postural workloads
  - Manual Materials Handling
  - Whole-Body-Vibration (WBV)

Combination with OD 2110

Integrated database of load weights

<table>
<thead>
<tr>
<th>Code</th>
<th>Lastbezeichnung</th>
<th>Gewicht</th>
<th>Ermittlungsart</th>
<th>Bemerkung</th>
</tr>
</thead>
<tbody>
<tr>
<td>22</td>
<td>Getränkekasten Schweppes 0,5l</td>
<td>17,5</td>
<td>gemessen</td>
<td>18 x 0,5 l</td>
</tr>
</tbody>
</table>
Integration of figures, pictures, videos and related exposure data

Anamnesis software OD 2108

... and whole-body vibration exposures

Anamnesis software OD 2110
Whole-shift workload monitoring with CUELA*

(Computer-assisted registration and long-term analysis of physical workloads)

Optional modules:
- Heart rate
- EMG
- 3D Force
- WBV/HAV

Data assessment with CUELA software

Measurement data, e.g. angle time graph

3D-Puppet

Synchronised video file
Gonkatast database on workloads of the lower limbs

Interface to biomechanical models

- Estimation of lumbar moments, compression forces,...
Laboratory research on situational lumbar loads

* cooperation with Matthias Jäger

Outlook: German Spine Study “EPILIFT”

Epidemiological multi-center case-control study that aims to estimate the dose-response relationship between occupational exposure to physical loads and lumbar discal diseases

presentation of Matthias Jäger
THANK YOU for your attention!

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