Osteopathic Treatment of Discogenic Problems

Christian Fossum, D.O.
Introduction: Setting the Scene
## Classification of Spinal Disorders

### Classification of Spinal Disorders (after Boos, 2008)

<table>
<thead>
<tr>
<th>Specific Spinal Disorders</th>
<th>Non-specific Spinal Disorders</th>
</tr>
</thead>
<tbody>
<tr>
<td>With clearly identifiable pathomorphological correlate such as (10 – 15 %)</td>
<td>Without clearly identifiable pathomorphological correlate (85 – 90 %)</td>
</tr>
<tr>
<td>▪ Congenital</td>
<td>▪ Non-specific axial neck pain</td>
</tr>
<tr>
<td>▪ Developmental</td>
<td>▪ Non-specific axial dorsal pain</td>
</tr>
<tr>
<td>▪ Traumatic</td>
<td>▪ Non-specific axial back pain</td>
</tr>
<tr>
<td>▪ Infectious</td>
<td></td>
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<tr>
<td>▪ Tumorous</td>
<td></td>
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<tr>
<td>▪ Metabolic</td>
<td></td>
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<tr>
<td>▪ Degenerative (depending on the disorder)</td>
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</table>

There are many potential causative and aggravating factors associated with this category, but no structural pathology can with certainty be held responsible.

### Structure / Pathology

<table>
<thead>
<tr>
<th>Structure / Pathology</th>
<th>Prevalence</th>
<th>Source</th>
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| Discogenic pain (IDD)
^1 | 39% - 42% | Schwarzer et al 1995, DePalma 2011 |
| Zygapophyseal Joints
| Sacroliliac Joints
^3 | 6 – 13% (16 – 21%) | Schwarzer et al 1995, Bogduk 1995 |
| Nerve root (radicular pain) | 2 – 10% | Deyo et al 1994, Govind 2004 |
1. **Nociceptive back pain**
   - Ligaments in the lumbosacral spine
   - Lumbar zygapophyseal joints
   - Sacroiliac joints
   - Posterior surface of the lumbar intervertebral disc

2. **Somatic referred pain**
   - Lumbar zygapophyseal joints
   - Lumbar intervertebral disc
   - Myofascial triggerpoints (MTrP)

3. **Radicular pain**
   - Pain evoked by ectopic discharges emanating from a dorsal root or its ganglion → disc herniations and inflammation of affected nerve seems to be the critical pathophysiologica**

4. **Radiculopathy**
   - Neurological state in which conduction is blocked along a spinal nerve or its roots. It is not defined by pain but by its objective neurological signs
General Classification of Disc Lesions

- Normal
- Congenital / developmental variant
- **Degenerative / traumatic lesion**
  - Anular tear
  - Herniation
    - Protrusion / Extrusion
    - Intravertebral
  - Degeneration
    - Spondylosis deformans
    - Intervertebral osteochondrosis
- Inflammation / Infection
- Neoplasia
- Morphologic variant of unknown significance

**Internal Disc Disruption (IDD)**

![Diagram of Internal Disc Disruption (IDD)](image)

**Disc Prolapses**

![Diagram of Disc Prolapses](image)

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In human and animal models of degenerating IVDs, especially painful IVDs, it has been observed that innervation is increased and that the nociceptive nerve fibers grow into what are usually aneural inner parts of the AF and even into the NP, sometimes together with blood vessels.

It has also been observed in degenerated IVDs an increase in the number of Golgi-tendon organ-like structures such as Ruffini’s and Pacinian corpses.

In addition to sensory nerve fibers, there is growing evidence that sympathetic afferents are also increased in degenerated IVDs and that they play a significant role in LBP.

Innervation of the disc

- Each lumbar disc is innervated by multiple sources

- Anterior and lateral the anulus receives nerves derived from branches of the sympathetic trunk and its grey rami communicantes

- Posteriorly the annulus receives branches derived from the sinuvertebral nerves, which are the recurrent meningeal branches of the lumbar ventral rami

Innervation of the disc

Sympathetic trunk and its grey rami communicantes (gr)

Anterior

Posterior

Sinusvertebral nerve
Innervation Lumbar ZAJs: Dorsal Rami

Giles (1989, 2009)
This study looked at the predictive value of pain localization relative to structures causing it.

- N = 170, Average age 54.4 yr, LBP average 12 months
- Provocative discography, ZA- and SI joint blocks
- Discogic (IDD), Lumbar ZAJ og SI joint pain
- Calculated sensitivity, specificity, positive and negative predictive value, diagnostic accuracy and LR +/-

- Pain median (over the SPs) → IDD and reduces the likelihood for ZAJ and SIJ as pain generators
- Isolated paramedian pain → increased likelihood for ZAJ and SIJ as pain generators

Schematic hypothesis for a reflex system for motion segment stabilization

Osteopathic Manipulative
Considerations of Discogenic Problems
LBP: one of the leading causes for why patients seek medical care

97% of all LBP are of a mechanical nature (Deyo et al, 2001)

“Tissue causing symptoms” prevalence lists three major progenitors of LBP:
- Lumbar IVD 39%
- Lumbar ZAJ 15 – 40%
- Sacroiliac Joints 16 – 21%

Patients with CLBP have greater severity of diagnostic findings characterizing the somatic dysfunction (TART)

Studies and Guidelines support that Osteopathic Manipulative Treatment (OMT) is effective in management of LBP


- NICE Guidelines. Low back pain: the acute management of patients with chronic (longer than 6 weeks) non-specific low back pain. Issued May 2009, (The National Collaborating Center for Primary Care and the Royal College of General Practitioners, United Kingdom)

OMM for Pain Reduction

- Pharmacologic studies in humans and animals have begun to decipher potential mechanisms in the central nervous system underlying the analgesia produced by joint manipulation.

- The non-opioidergic descending inhibitory pathways (serotonergic and noradrenergic) seem to be the major players.

- Clinical context
  - Treatment of non-injured adjacent areas may result in pain reduction through these mechanisms.
  - This has been confirmed in experimental studies (Skyba et al, 2003, Hoeger-Bement and Sluka, 2006, Sluka, 2006)

- Effect is most likely non-segmental but more depending on CNS response.

Descending pain inhibitory pathways from the PAG via the RVM to the dorsal horn of the spinal cord: one of the CNS mechanisms involved in the hypoalgesic effect of manipulation.

Loyd DR, Murphy AZ. The Role of the Periaqueductal Gray in the Modulation of Pain in Males and Females: Are the Anatomy and Physiology Really that Different? Neural Plasticity 2009
Specific Spinal Pathology:
- Biomechanical Theory
- Imaging Findings

Patient Response Characteristics:
- Subgroup Identification
- Clinical Outcome

Exclusion of red flags (<1%)
- Diagnostic work-up
- Classification of LBP
  - Nociceptive back pain
  - Somatic referred pain
  - Radicular pain
  - Radiculopathy
- Management plan specific to patho-anatomical and functional changes

DIRECT METHODS
- Biomechanical – Postural Model
- Neurological Model
- Respiratory – Circulatory Model
- Biopsychosocial Model
- Metabolic Model

INDIRECT METHODS
- Postural Control and Movement
- Integrated Autonomic Function
- Circulation
- Behavior and Adaptation
- Metabolic, Immune and Endocrine

The Total Musculoskeletal System: “Primary Machinery of Life”

DIRECT METHODS
- Symptom Reduction
  - ”Motion is Lotion”

INDIRECT METHODS
- Physiological Response

COMBINED METHODS
- HOMEOSTATIC METHODS

OMT
Proposed Sequencing

Respiratory – Circulatory Model:
- Venolymphatic drainage ↑
- Arterial supply ↑
- Pressure nerve root ↓
- Absorption disc material ↑
- Improved biochemical environment around nociceptors

1. Treat the thoracic inlet
2. Treat the respiratory diaphragm
3. Release the lesser omentum
4. Perform the liver pump
5. Release the mesenteries
6. Move fluids: lymph pumps

Biomechanical – postural model and neurological model
- Nociception and pain ↓
- Function and motion ↑
- Biomechanical stress ↑
- Optimizing load transfer
- Sensorimotor control ↑

1. Treat the thoracolumbar junction
2. Treat the psoas muscle
3. Treat motion segment restrictions in the lumbar spine
4. Treat the pelvic girdle
5. Rhythmic traction lumbar spine
6. Treat the neural tissues
Respiratory – Circulatory Considerations
Thoraco-Abdomino-Pelvic Pump


- Respiration is an activity where numerous systems and all body tissues are involved (Cathie, 1965, 1974)

- Thoracoabdominal junction: vertical and transverse plane where we have integration of somatic, respiratory, vascular, neural and visceral functions (Cathie, 1974)

- < 23,000 respiratory cycles per day

- The diaphragm is the extrinsic pump of the venous and lymphatic system: asymmetries with reduce the respiratory efficacy through distortion of the cylinder (Zink, 1970, 1973, 1977, Mitchell, 1984)

- Important in LBP and discogenic conditions
Circulatory Considerations

- The vessels of the venous system can also play a role in the generation or worsening of disk-related symptoms

- Relevant anatomy
  - The valveless veins of the spinal canal form an uninterrupted anastomotic chain running from the skull base to the sacrum
  - The degree of filling of the lumbar epidural veins depends on the central venous pressure
  - The venous plexus of the spine are also a venous pathway connecting the superior and inferior vena cava
  - Together with the azygos system, they form a collateral venous circulation that operates beyond the local level, coming into play physiologically whenever the venous pressure is elevated in the thoracic, abdominal, or intracranial cavities
  - Elevations of pressure in the chest and abdomen worsen disk-related pain because they increase the degree of filling of the epidural veins

- Clinical considerations
  - Reduce congestion
  - Influence absorption of material from extrusion & sequestration
The Thoracic Inlet Region

- HVLA to treat upper thoracic segments
- Treatment of 1st Rib → FPR / Still – Technique
- Treatment of AR1 with Counterstrain → also releases the thoracic inlet
- Myofascial release of the thoracic inlet with pumping to move fluids

Gaughran GR. Suprapleural membrane and suprapleural bands. Anat Rec 1964; Apr; 148: 553 - 559
The Respiratory Diaphragm

Treating the respiratory diaphragm in patients with discogenic pain is important for numerous reasons: it influences the musculoskeletal system in the thoracolumbar spine, the AVL systems and the visceral system.

Potential causes of diaphragmatic dysfunction:

- C3 – C5 somatic dysfunction
- Ligamentous strain from pericardiac ligaments
- Rib somatic dysfunction
- Lower thoracic somatic dysfunction
- Upper lumbar somatic dysfunction
- Psoas muscle
- Quadratus lumborum muscles
- Visceroptosis
- Posture

Pettiaux N et al. Three-dimensional reconstruction of human diaphragm with the use of spiral computed tomography. J Appl Physiol 1997; 82(3): 998 - 1002
Lesser Omentum

W Thiel (2002), Gregoire & Oberlin 1991
Visceral or ventral manipulative techniques can be used in the abdominopelvic region to reduce congestion and improve circulation to the viscera:

- The root of the mesentery is often treated in patients with upper GI dysfunction
- The mesenteric lift is used to reduce congestion and improve circulation to the small intestines
- This congestion is often associated with visceral ptosis

- Carl P McConnell, D.O. considered the root of the mesentery to be the axis of movement for all abdominal organs during respiration
- The root of the mesentery is frequently hypothesized to be a common cause of recurrent lumbar spine somatic dysfunctions

Perlemutter and Wagilora (1976)
These procedures should not be used if the patient has an abdominal incision, acute ischemic bowel disease, aortic aneurism, obstruction, or similar condition.
Objective: to release the mesenteries to help decongest and improve circulation to and from the organs

For the root of the mesentery, place your hands inferior to an imaginary line spanning from 2cm superior and 2cm lateral on the left side of the umbilicus to the ileocecal junction

‘Lift’ the root in the direction of the patient’s right axilla

When tension is felt, the other hand will do gentle oscillations of the right lower extremity

Technique is performed until a softening is felt under the hand contacting the root

For the mesenteries of the ascending and descending colon, the hands is gently pushing either of the colons towards the patient’s midline, and held until a softening can be felt
Biomechanical – Postural and Neurological Considerations
LBP of Thoracolumbar Origin

- LBP of thoracolumbar origin is common in clinical practice, it may be acute or chronic, and its character is similar to that of pain of lumbosacral origin.
- This may also include pseudovisceral abdominal pain, pubic and trochanteric tenderness associated with this.
- Note the anterior ramus (1): groin pain of discogenic origin has recently been demonstrated in L2 distribution.

Distribution of spinal nerves T12 and L1:

1. Anterior ramus
2. Posterior ramus
3. Perforating lateral cutaneous branch


TL Junction: Biomechanical Stressinducer

- The lumbar zygapophyseal joints (ZAJ) are designed to limit or block axial rotation.
- The ZAJ protect the intervertebral disc from excessive torsion.
- Although approximating the sagittal plane, the surface of the lumbar ZAJ are either flat, C–shaped or J–shaped.
- On average there is $2 \sim 3^\circ$ of axial rotation possible per segment.
- There is a sudden change of joint structure occurring in the region of a single vertebra T12: orientation of ZAJ changes abruptly.
- Lack of axial rotation in the lumbar spine is compensated at this junction.
- Motion restriction at T12 may increase the biomechanical stress in the lumbar spine.

### Principles HVLA in the Thoracic Spine: Sagittal Plane Techniques

<table>
<thead>
<tr>
<th>(a)</th>
<th>(b)</th>
<th>Contact is made with the <strong>inferior</strong> vertebra in the somatic dysfunction. With either (a) flat hand or (b) a fist, the transverse processes of that vertebra is contacted.</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Diagram" /></td>
<td><img src="image2" alt="Diagram" /></td>
<td>Keeping the motion purely in the sagittal plane, the patient is brought into flexion until the motion can be felt at the dysfunctional segment.</td>
</tr>
<tr>
<td><img src="image3" alt="Diagram" /></td>
<td><img src="image4" alt="Diagram" /></td>
<td>Using your body, a thrust is given in an postero-superior direction. The hand contacting the inferior vertebra in the somatic dysfunction is acting as a fulcrum upon which the superior vertebra is moved.</td>
</tr>
</tbody>
</table>

Fossum (2007)
Thoracic HVLA: the Dog Technique

- Similar to the ‘Kirksville – Crunch’ with modifications to planes of treatment and position of the hand the thoracic vertebra or the rib being treated
- Allows you to limit the pre-thrust tension to one plane of motion, thus minimizing the stress on painful structures
- Because the technique aims at separating (cavitation) rather than gliding joint surfaces, the joint can be treated in its relative neutral, minimizing stress on painful structures
So what then is the function of the psoas muscle?

- One of the primary functions is stability of the lumbar spine (Bogduk et al., 2002, Gibbons, 2007)
- This is because the axial compression is bigger than the shear forces acting on it (McGill, 2002)
- Because the muscle crosses the pelvis and the SIJ it may contribute to stability of the SIJ
- Because of its pivot point on iliopectineal eminence and the resulting leverage it will cause a posterior rotation of the innominate (Gibbons et al., 2001, Gibbons, 2007)
- The iliac muscle will rotate the innominate anterior in an anterior direction (Neumann, 2010)
- The antagonistic functions of these two muscles on the pelvis contributes to the axial compression of the lumbar spine and stability of the lumbosacral junction (Neumann, 2010)
Psoas Muscle and Discogenic Pain

- The axial compression on the lumbar IVD from the psoas muscle may negatively influence both the cell mechanics and the extracellular matrix mechanics in the anulus fibrosus of the IVD.

- Unilateral axial compression from psoas muscle on one side only may shift the nucleus pulposus (bulging or extrusion) and also increase the torsional stress on the annulus fibrosus (→ pain from radial fissures).

- The axial compression on the lumbar spine from the psoas muscle may also restrict motion segmentally in the lumbar ZAJ with exacerbates the condition at the involved FSU.

Testut and Jacob (1923)
Typical Pattern:

The Progenitor:

- Type II Somatic Dysfunction TL Junction Region
- Psoas Tension +++
- Axial Compression or Rotational Stress Lumbar IVD
- Sacral Rotation on Oblique Axis / Sacral Torsion or Unilateral "Shear" in the form of a Unilateral Sacral Flexion

SD and Stress L5 – S1

Piriformis Tension +++
Suggestions on treating the Psoas Muscle

- Treatment of the thoracolumbar junction and upper lumbar spine prior to treating the psoas muscle in patients with discogenic pain
- Counterstrain: this technique is helpful in addressing the psoas muscle specifically. Although the position requires a great deal of flexion with SB and rot, patients with discogenic pain usually tolerate it well
- If condition is very acute, consider holding the position of comfort for longer than 90 seconds
- James Cyriax, M.D. used the “Dallison Technique” (see picture) on patients with acute discs
- This technique bears resemblance to how osteopathic physicians treat the psoas muscle using counterstrain

Muscle Energy Techniques (MET)

- If tolerated by the patient → seated position
- Use translatory motions
  - A – P translation for flexion and extension: may prevent unwanted movement of the nucleus pulposus as with pure F or E
  - Lateral translation: with the sidebending component the coupled rotation will follow automatically. Less concerns about altered coupling behavior at FSU
- PIR variation: restore motion at FSU
- Ruddy variation: reduce venolymphatic congestion

MET can also effectively be used to improve sensorimotor control of the spinal motion segment

- Ensure to keep to contraction effort from the patient light in order to prevent recruitment from the polyarticular muscles

Combined Leverage and Thrust in the Lumbar Spine in Patients with Discogenic Pain

Advantages:
Using combined leverages allows the operator to manufacture a pre-manipulative barrier within the physiological range that is usually not at the end-point. This minimizes stress on tissues and is done short of pain for patient

- The spine is kept in a neutral position and the technique utilizes physiological locking of the spine from above and below (e.g. myofascial locking as opposed to approximation of joint surfaces)
- Why neutral position?
  - Mathematical analyses of the lumbar IVD shows that with bending moments (flexion) the stress on the AF is 450 times greater than with spinal rotation and they conclude that there is no radial expansion or extrusion (bulging) during twisting*
  - Extension may aggravate the patients symptoms
  - In neutral there is less stress or strain on inflamed or injured tissue (pain ↓)

Lumbar HVLA: Targeting Right ZAJ

- **Theoretical Consideration:**
  - Separate the right zygapophyseal joint
  - \( \text{ERS}_{\text{RIGHT}} \) (right ZAJ “will not open”) or \( \text{FRS}_{\text{LEFT}} \) (right ZAJ “will not close”)

- **Leverages:**
  - Upper lever: use primarily side-bending (“soft-tissue locking”) down to the superior vertebra in the dysfunction
  - Leg closest to table is used to bring the segment being treated into neutral
  - Upper leg is flexed until movement is felt at the inferior vertebra in the dysfunction

- **Approximation:**
  - Patient is “rolled” en-bloc towards the clinician and clinician approximates the patient leaving no space between them

- **Momentum Induction:**
  - Use of gentle rocking movements of the patient until a state of relaxation is obtained

- **Thrust:**
  - Body-drop: “wagging the tail”
1., 2. and 3. degree lesions

- The **first degree lesion** is a simple uncomplicated movement in which the axis of movement is unchanged and is still safe within the nucleus of the intervertebral disc

- In the **second degree lesion** there is a change in the position of the axis, and the vertebra in combination with its neighbors begins to swing in reverse rotation and “collapse into its curve” in the effort to sustain the weight from above
  - What puzzled many with the second degree lesion is the “fact” that the spinous processes does not cross the mid-line of the body although the transverse processes reverse their positions anterior and posterior
  - The spinous processes is closer to the midline and it is closely approximated to the spinous process below
  - The mechanics is entirely different from the first degree type and demand a technique of correction that is entirely different

- The **third degree lesion** is merely an extension of the second degree lesion to the opposite side and is an extremely difficult condition to treat
• Under increased loading or weight bearing, the tripod provides stability with flexibility of movement
• When only one leg of the tripod is weight-bearing, alteration of position by the vertebra is easy. This is especially true when the nucleus pulposus if the IVD is the point as in flexion (FB)
• When two legs of the tripod, as in side bending or extension (BB), are weight-bearing, alteration in position of the vertebra is more difficult. But the position is not stable as it is when all three are functioning

Rotation can take place around any of the three vertical axes (nucleus pulposus or either of the ZAJ)
• There are four axes about which a vertebra may tip (‘tipping movements’) from the horizontal plane:
  • In flexion the vertebra tips forward around a axis through the nucleus pulposus
  • In extension the vertebra tips backwards around an axis running though both inferior articular facets
  • In side-bending there is a tipping about a diagonal axis passing through the inferior articular facet and the nucleus pulposus below the body
The Second Degree Lesion

- **2\textsuperscript{nd} degree lesion:** "Discocorporeal Lesion"
- **Violates normal physiological axes of motion**
- **Places great stress on the functional spinal unit (FSU)**

- Similar to ideas such as "complicated lesion" (Hoover) and "Derailed lesions" (Fryette)
- Can be caused by trauma
- Can be caused by superimposed dysfunctions → Type II mechanics superimposed on Type I mechanics

Mobility testing:
- **Hypermobile**
- **VERY restricted**

Posterior TP on the right side AND an SP that does NOT cross the midline despite the rotation (because of the shift towards the right)
The severity of a Type II superimposed on a Type I depends on the location:
- Where the curve crosses the midline: less severe for the patient (yellow)
- Closer to the apex of the: more severe (red)
### Example 2nd Degree Lesion with vertebra shifted to the right:

- Patient is comfortably seated.
- Contact the articular pillar of the inferior vertebrae in the FSU to be treated.
- The patient is flexed through posterior translation until localized to the FSU.
- The patient is translated to the right so that the vertebra is further shifted to the right side.
- Add a little rotation to the right.
- Use gentle compression from contact on patients shoulder towards the FSU.
- Use a suitable blend of “push and pull” and articulate the FSU in a “figure-of-eight” fashion.
- In this example to get the “motion going, start with left rotation and extension.
- Reassess the motion at the FSU.

The Force, Amplitude and Rhythm is adapted to the condition being treated.
Proposed Sequencing

Respiratory – Circulatory Model:
- Venolymphatic drainage ↑
- Arterial supply ↑
- Pressure nerve root ↑
- Absorption disc material ↑
- Improved biochemical environment around nociceptors

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