Cervical & Lumbar CASES

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Cervical Spine

Cases
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What is this?
Sagittal section through the upper cervical spine of an elderly man who had not had neck symptoms. The section is carried through the left lateral mass (C1) and the occipital condyle. The dark venous channels in the occipital bone are the hypoglossal canal on the left and a small portion of the sigmoid sinus to the right. The convex occipital condyle has a normal cartilage and articulates with the concave and moderately degenerated articular surface of the atlas (C1) which also displays subchondral sclerosis. The occipito–atlantal joint has a ball–and–socket shape that permits flexion–extension and lateral bending. By contrast, the atlanto–axial joint (C1–C2) facilitates axial rotation (around the axis of the odontoid process) by translation (sliding) of the 2 convex joint surfaces. Meniscoid synovial folds project into the C1–C2 joint space anteriorly and posteriorly. The spaces above and below the arch of the atlas are occupied by wide venous sinuses. Between the occiput and C1 the vertebral artery (red) and the small C1 nerve behind the artery are completely surrounded by the venous sinusoid, between the C1 lamina and the pars interarticularis of C2 a venous cavern surrounds the large C2 root ganglion (yellow).

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What is this? What is the likelihood of pain?
Sagittal close-up section through the level of the lateral recess of a severely degenerated lower cervical spine of a completely asymptomatic 64–year–old woman. The vertebra in the center is C5. Both adjacent discs are degenerated with a roughly 50% decrease in height and internal disruption of the annulus fibrosus and absence of a nucleus pulposus.

At C4–C5 the disc height reduction is more pronounced and small spondylosis endplate osteophytes are seen anteriorly and posteriorly. Behind the disc the root sleeve traverses the lateral recess, there is no compression of the root sleeve which carries cerebrospinal fluid surrounding the nerve roots, the epidural veins are wide and patent. At C5–C6 there is an extruded disc. This teardrop–shaped fragment completely obliterates the lateral recess and compresses the root sleeve (also emptying its CSF content) and also displaces the root inferiorly. While it is questionable whether the disc fragment still is contained posteriorly, it still is in continuity with the substance of the disc anteriorly. The upper portion of the herniated disc has dissected its way underneath the periosteum of the vertebra above. There also is a slight infolding of the ligamentum flavum.

Cervical Anatomy and Pathology -
Degenerated Cervical Spine
Severely Degenerated Lower Cervical Spine
64 Year Old Man (??)
Written by Wolfgang Rauschning, MD

Lower cervical 64yo M (severe DDD/DJD)
Search our Spinal Case Study Library

Spinal Stenosis – Unresponsive to Nonoperative Treatment
Presented by: J. Highsmith MD
A 65-year-old male with multiple medical problems reports a long history of low back and leg pain with difficulty walking upright, especially during the last several months.

Pseudofusion Dilemma
Presented by: J. Highsmith MD
Patient History: A 53-year-old, nonsmoking woman came to the clinic with increasing back and right leg pain despite undergoing an L4-S1 Transforaminal Lumbar Interbody Fusion (TLIF) and lateral mass fusion with Bone Morphogenetic Protein (BMP) just 8 months prior. She initially had surgery for sever

Reactive Scoliosis
Presented by: A. Methold MD
Patient History: The patient is a 13-year-old male who feels mid-thoracic pain. An active junior high student who enjoys playing basketball, 7 months ago he woke up with back pain. Since then, the pain has continued, growing progressively worse. The pain is present at all times, becoming worse with

Adult Onset Scoliosis
Presented by: A. Methold MD
Patient History: The patient is a 31-year-old male with back and right lower extremity pain. His pain started 6 months ago and is unrelated to reauem. He feels the
Showing Case Studies for: Chiropractic

Competitive Equestrienne: Incapacitating Low Back Pain
Presented by R. Fessler MD, PhD
Case about a 32-year-old female equestrienne with incapacitating low back pain unresponsive to non-surgical care.

Cervical Radiculopathy: Classic Case?
Presented by R. Fessler MD, PhD
The patient is a 45-year-old male with a 3-month history of neck, shoulder and arm pain.

Bilateral L2 Spondylolysis: Nonsurgical or Surgical Treatment?
Presented by M. Schafer MD
This 29-year-old former college football player presented with sharp stabbing pain in the upper lumbar spine.

Lumbar Degenerative Disc Disease: History of Low Back Pain
Presented by R. Fessler MD, PhD
The patient is a 62-year-old male with a three year history of low back pain that prevents normal activities. Although leg pain is minimal, it is increased with activity and decreases when lying down.

Constant, Nonradiating Low Back Pain
Presented by R. Fessler MD, PhD
Although the patient has reported intermittent low back pain during years past, now her pain has become constant but does not radiate.

Trans-sacral Approach to Chronic Low Back Pain
Presented by B. Hart MD
After prior lumbar microdiscectomy procedures (years ago), both at L5-L6, the patient presents with chronic low back pain.

Cervical Degenerative Changes with Segmental Kyphosis
Presented by M. Weinstein MD

http://www.spineuniverse.com/professional/case-studies/browse/chiropractic
Case 1

Patient History

The patient is a 45-year-old male. He has a 3-month history of left neck, shoulder, and arm pain. His pain radiates through his radial forearm to his thumb and first finger.

SGY: WHAT ARE YOUR 1ST THOUGHTS REGARDING DX (given this limited info)?

http://www.spineuniverse.com/professional/case-studies/browse/chiropractic
Case 1

Patient History
The patient is a 45-year-old male. He has a 3-month history of left neck, shoulder, and arm pain. His pain radiates through his radial forearm to his thumb and first finger.

Examination
The patient's neurological examination revealed 4/5 strength in the left bicep, decreased bicep reflex on the left, and decreased pinprick in the thumb and first finger.

Prior Treatment
Previously, the patient tried narcotic analgesics, massage, physical therapy, and chiropractic care. These nonsurgical treatments did not bring pain relief.

SGY:
• IS YOUR DX SUPPORTED BY THE OBJECTIVE FINDINGS?
• WHAT (if any) PE TESTS WOULD YOU DO BESIDES THE NEUROLOGICAL EXAM DESCRIBED ABOVE?
Case 1

**SGY:**

• *What do you see (in spite of the poor quality)*?
• *Given the Hx/PE, what level do you think this is?*
Case 1

• Does this confirm your Dx noted on the axial view?
Case 1

Suggest Treatment

• *Indicate how you would treat this patient*

Figure 1: Axial MRI C5-C6. Left central and foraminal disc herniation is noted.

Figure 2: Sagittal MRI. Disc herniation is noted at C5-C6.

**Diagnosis**

Herniated disc at C5-C6.
Case 1

SGY: (their options)

What treatment do you suggest? *

- Anterior cervical discectomy without fusion
- Anterior cervical discectomy with fusion
- Open posterior cervical laminectomy
- Open posterior cervical discectomy
- Minimally invasive anterior cervical discectomy with fusion
- Other

Figure 1: Axial MRI C5-C6. Left central and foraminal disc herniation is noted.

Figure 2: Sagittal MRI. Disc herniation is noted at C5-C6.

Diagnosis

Herniated disc at C5-C6.
Selected Treatment
Minimally invasive anterior cervical discectomy with fusion at C5-C6.

Figure 3. Post-operative lateral x-ray.

Figure 4. Post-operative PA x-ray.
Case 1

Outcome
The patient experienced immediate pain relief. His strength and sensation returned over a 6-week period.

Case Discussion
Case 1

Outcome
The patient experienced immediate pain relief. His strength and sensation returned over a 6-week period.

Case Discussion
Todd Albert, MD
James Edwards Professor & Chairman of Orthopaedic Surgery
Jefferson Medical College, Thomas Jefferson University
Philadelphia, PA

This case represents a classic presentation and the expected result for surgical treatment of a herniated disc with cervical radiculopathy. I am slightly surprised by the description of symptoms and findings, as I would expect a C6 radiculopathy with a herniation at C5-C6. This typically presents with pain as described into the neck, arm, and thumb/first finger. Patients also present with classic wrist extensor weakness, although bicep weakness can be seen.

Of the options presented, I believe there is good evidence now for choosing one of three options for this patient:

1) Anterior cervical discectomy and fusion
2) Laminoforaminotomy and discectomy
3) Anterior Cervical discectomy and disc replacement

All have shown excellent and durable results in terms of pain relief, neurological recovery, and a very acceptable complication rate. I think there is less evidence to support equivalent results for the other options listed.

Finally, I would note that it is redundant to call the procedure a minimally invasive anterior cervical discectomy and fusion, as the original procedure as described is through a minimal aperture with little tissue disruption and no muscle destruction. The x-ray looks good, but I do have concerns that the plate is very close to the disc space above, which can increase the risk of adjacent segment ossification.
Case 2 (C-Spine)
HISTORY (7-30-12)

• KP 63yo F Caucasian; retired school teacher
  – Neck & LT UE pain/paresthesia (chronic / recurrent since 1985; had exacerbation in April/2012)
  – **Mech.of injury**: fishing – repetitive motion reeling in line & holding the rod
  – **Onset**: acute 7-28-12 (presents 7-30-12) but had some localized LT neck pain since daughter’s wedding 5-2012 & exac. 7/21-22/2012 cleaning house (EAA)
  – **Pain incr.**: Sleeping/laying (2-3hrs max/night); neck ROMs ↓, esp. extension + LLF
HISTORY 7-30-12 (continued)

- KP 63yo F Caucasian; retired school teacher
  - Pain decr.: C-flexion, LT arm over head, ice, Tyelino [NSAIDs contraindic. d/t cardiac med./ Metoprolol succinate (Toprol XL) interaction]
  - Quality: achy, burning, numb/tingling
  - Radiation/location: LT neck to interscap, LT UE to hand (D2-4)
  - Severity: Now 10/10; Ave. 8/10; Best 4/10; Worst 10/10; Bournemouth – Cervical = 86%; ADL limitations 8/10
  - Timing: Constant but worse at night/laying
  - Past Hx: + neck pain / - radiculopathy; Hx of CTS; Dx of fibromyalgia 30 yrs previously
  - Red Flags: No Hx of fever, infection, progressive neuro loss, b/bl paresis, or long-tract signs.
Time To Share!

• What is your initial impression after reviewing the history?
  – What PE elements will you concentrate on?
    • What are you expecting to find?
  – What diagnostic tests will you start out with?
• Observation:
  – Obvious distress (agitated, teary, holding arm over head or in sling-like position, stressed).
  – Cannot tolerate laying prone or supine (immed. Paresthesia to D2-4 in prone position)
  – Posture: Anterior based occiput with C-flexion
• **Palpation:**
  - Paraspinal mm spasm/tenderness LT C4-T2 region
  - Fixation/joint dysfunction C5-7 (+ spring test LT)
  - Trigger points: LT upper trap, rhomboids, levator scapulae
• **Orthopedic provocative testing:**
  - C-Distraction = Decr. Neck & UE pain
  - MCRC = markedly + LT reproducing LUE w/in 1 sec. pain/paresthesia at 5-10% expected ROM;
  - C - ROM: Sagittal plane motion most impaired, esp. extension. FL tolerated to 30-40°, then rad., rotation was the most tolerated.
  - Ant. Scalene compression = LT UE paresthesia at 1 sec.
Physical Examination 7-30-12 (continued)

- **Neurological testing:**
  - **DTR’s:** 1/5 Triceps and wrist DTRs
  - **Motor:** 4/5 mm grade triceps, wrist fl., finger extensors (no fasciculation)
  - **Sensory:** Decreased triceps, palm & digit 3

**SGY:** What nerve root is most likely?
Time To Share!

• What is your current impression after reviewing the PE findings?
  – What PE elements support the DX best?
    • What other PE tests would you have done?
  – What diagnostic tests are you considering?
  – What treatment /management are you considering?
  – Any treatment contraindications???
Special Tests?

- X-ray:
- MRI / CT:
- EMG:
- Other:
X-Ray 3-7-07
X-Ray 3-7-07
X-Ray: 1985 vs 2007
X-Ray: 1985 vs 2007
X-Ray: 1985 vs 2007
X-Ray: 1985 only
X-Ray: 1985 vs 2007
X-Ray: 1985 vs 2007
Time To Share!

• What did we learn from the x-ray assessment and comparison?
• Any other tests desired?
• Any treatment contraindications re: CMT?
Treatment Plan

- **Treatment plan**: 3x/wk for 1 month (re-eval at 2wk point)
- **CMT**:
  - prone C7/T1 RT to LT (PR or LP listings)
  - Supine C6 RT rotation (PR or LP listing)
  - Manual C-Tx, fig. 8, mobilization
  - T5, 6 Anterior supine CMT (prone PA mid-thoracic adj. = C-extension increased symptoms pre-CMT so not performed)
- **Modalities**:
  - In-office: Pulsed Magnetic Field, Class IV Laser
  - Home: Over the door cervical traction and a portable traction collar; ice 15 min. x3
- **OTC’s**: Tyelinel (NSAIDs contraindicated d/t Cardiac meds)
  - Metoprolol succinate (Toprol XL) Tablet Extended Release 25mg
- **Advice**: Avoid ADLs that reproduce radicular pain
- **Exercise**: Promoted positions that centralized radicular pain
Compliance with care

- Unable to make every appt d/t travel plans
- Very compliant with cervical traction, ice, ADL modifications
Re-Exam(9-24-12)

- Total of 15 treatments (7/30 – 9/24/2012)
- **Recovery** = 85-90%; Global Impression of Change: Very Much Improved; Bournemouth – Cervical (initial 7/30/12 = 86%, 9-24-12: 24%); ADL NRS: 8/10 to 1-2/10 (7-30 vs. 9-24-12); Ave. Pain NRS: 8/10 to 2-3/10.
- **P**: (Pain)
  - Increases w/ end-point C-Ext+LT rotation; laying supine on floor (C-Ext)
  - Decreases w/ Treatments, C-Tx; no longer needs to place arm over head or modify ADLs at this point
- **Q**: Achy, stiff, tight
- **R**: Lt neck to left index finger tip (3rd digit paresthesia resolved completely by late August)
- **S**: Pain levels: Now 2/10, Ave. 2-3/10, best 1/10, worst 5/10 (1 day over past 12 days/last appt)
- **Home Tx**: Uses C-Tx bid (was ave. 5x/day, now 2x/day); no Tylenol
- C-ext 45-50° w/o rad but can’t lay supine on floor w/o a pillow. No problems sleeping in bed.
Re-Exam(9-24-12)

• **PE**
  – **Observation:** No apparent distress, neg. Bakody’s, C-ROMs full/no hesitation except combining C-ext+LLF
  – **Palpation:** LT C5, 6, 7
  – **Ortho:** + MCRC at 70% expected ROM w/ incr. LT scap tender w/o LT UE paresthesia at 7 sec.; Ant. Scalene compression + LUE paresthesia at 8 sec.
  – **Neuro:** 2-/5 (sluggish) LT Triceps; 5-/5 Lt Triceps, 4/5 finger extensors; decr. Pin D2 tip (D3 L=R)
Re-Exam(9-24-12)

- **Special Studies**: None
- **Treatment Plan**: Due to traveling plans, 10-3-12 next appt., then no treatment for 3 weeks. Continue home traction devices bid.
Self-care / home applied approaches used in this case

• 7/30/12: Recommended a Medrol Dosepak but there is no time to coordinate this with her primary care physician and she is unsure if her inability to take NSAIDs due to cardiac medication would applied here. I issued a portable cervical traction device to be used in the car and multiple times throughout her trip this week to Northern Michigan.

• 8/6/12: Continue using the cervical traction pump device at least 5+ times a day & ice; no Medrol Dosepak due to prednisone sensitivity and NSAID intolerance.

• 8/10/12: Patient will start doing the over-the-door cervical traction in addition to the cervical collar after this weekend’s camping trip.

• 8/17/12: Continue cervical traction 5 times a day or more. She is not a candidate for a Medrol Dosepak due to medication side effects.

• 8/24/12: Improvement in her driving tolerance is reported. She is traveling up north and will use her cervical collar traction unit.

• 9/24/12: Patient states that she will be traveling for approximately 3 weeks in October, 10/4-10/24 and is concerned about condition- she will come in on 10/3/12.
10-3-12 exacerbation

COMPLAINT: Neck and LT UE worse (HA’s have also returned)

- **Recovery**: 85-90% pre-exacerbation; back to about 75%.
- **MOI**: Hauled in and re-potted all her plants on 9/28/12 followed by carrying her purse and a bag across her shoulders & over her neck at the Cranberry Fest on Sat. 9-29-12. Since then, she reports an increase left brachial paresthesia which had been quite well controlled, with increased burning on dorsum of the LT hand & left index finger tip (very little digit 3 numbness).
- **P ↑**: C-Ext. + LLF (more intense); Laying supine on floor w/o pillow was tolerated since 9-26-12 appt. (+ again);
- **P ↓**: C-TX (incr. to tid vs. bid) helps both neck & HA (returned); ice to neck; use of pillow on floor (during exercises);
- **Q**: Increased intensity of achy/stiffness in neck, LT scap., and more LT scap pain, LT UE paresthesia
- **R**: LUE incr. dorsum LT hand/distal forearm, Sl. Paresth. LT D3, still D2 tip only,
- **S**: Now 4, on average a 3-4 (over the weekend), best a 0 and at worst a 4/10.
Re-Exam (10-3-12)

• **PE**
  
  – **Observation**: Mild distress, Sl. Bakody’s (prone lying), C-ROMs Incr. hesitation w/ combining C-ext+LLF
  
  – **Palpation**: LT C5, 6, 7; T1, 2; Incr. mm tight/tender para C’s L>R & nuchal ridge w/ +Tinel’s C2 HA distrib.
  
  – **Ortho**: + MCRC at 50% expected ROM w/ incr. LT scap pain w/o LT UE paresthesia at 5 sec.; Ant. Scalene compression + LUE paresthesia at 5 sec.
  
  – **Neuro**: 2-/5 (sluggish) LT Triceps DTR; 5-/5 Lt Triceps mm, 4/5 finger extensors mm; decr. Pin D2 tip (D3 still L=R, WNL)
Re-Exam(10-3-12)

• **Special Studies:** None

• **Treatment Plan:** Traveling plans 10-3 to 23-2012 next appt. 10/24 (re-eval.).
  
  – Continue home traction devices tid or prn.
  
  – Consider MRI/EMG-NCV
Discussion

• Comments about risks of advanced neuro loss?
  – When should I “pull the plug” & get a surg. Eval.?

• Other non-surg options (note NSAIDs contraindication)?
  – Comments about pros/cons of waiting for ESI referral?
2012 to 2016 **UPDATE**

- Pt (KP) has been VERY compliant w/ home therapies
- Seeks care between traveling (ave. q 4-8 wks)
- Travels w/ C-traction (pump collar & OTD)
- Has intermittent LT UE paresthesia / pain (+ Bakody’s Sign is common, Ant. Scalene Compression, weak C6 &/or C7 mm / + pin prick)
- **Happy w/ non-surgical management (no ESI’s d/t a reaction to a Medrol DP)**
Case 3 (C-Spine)
Case 3 (C-Spine)

Patient History

The patient is a 44-year-old female who presented with a 6-month history of left-sided neck, periscapular, and arm pain. She also noted paresthesias in her left arm toward the radial forearm, thumb and index finger. She is a nonsmoker.
Time To Share!

• What is your initial impression after reviewing the history?
  – Any “preliminary” diagnoses?
  – What PE elements will you concentrate on?
    • What are you expecting to find?
  – What diagnostic tests will you start out with?
Case 3 (C-Spine)

Prior Treatment

Despite treatment with medications, 6-weeks of physical therapy, and chiropractic care, her symptoms persist.

SGY: What Dx / imaging tests would you order?
Case 3 (C-Spine)

Examination

Electromyography and nerve conduction studies were consistent with C6 radiculopathy. A C5-C6 selective nerve root block was diagnostic for C6 radiculopathy.
Case 3 (C-Spine)

Images

Cervical spine radiographs revealed degenerative changes and loss of disc space height at C4-C5 and C5-C6 with segmental kyphosis C4-C5. (Figures 1, 2 – prior slide)

SGY: Any other tests/imaging?
Fig’s 3, 4, 5:
Axial MRI of C4-5, C5-6, C6-7, resp.
Case 3 (C-Spine)

SGY: What is your diagnosis?
Case 3 (C-Spine)

**Diagnosis**

Cervical degenerative changes causing loss of disc space height at C4-C5 and C5-C6, and segmental kyphosis at C4-C5.

SGY: What is your treatment plan?
Case 3 (C-Spine)

What treatment do you suggest? *

- Continue nonoperative care
- Cervical epidural injections
- Foraminotomies
- ACDF C4-C5, C5-C6
- Disc replacement C5-C6
- Disc replacement C5-C6 with ACDF C4-C5
- Other

SGY: Do you agree with these options?
Case 3 (C-Spine)

Selected Treatment

After 6-months of nonoperative treatment failed to adequately relieve her pain, the patient elected to undergo a 2-level anterior cervical discectomy and arthrodesis.

The patient is a nonsmoker and it was decided to use machined allograft and dynamic cervical plating. The surgical procedure was uneventful.

Anterior-posterior and lateral radiographs (Figures 6, 7), taken 3-months postop, demonstrate the Life Spine Kinetic® dynamic anterior cervical plate system used in this case.
3- months post-op
Case 3 (C-Spine)

Outcome

The patient experienced complete relief of her radicular pain prior to hospital discharge. A hard cervical collar was discontinued after 2-weeks. Radiographic evidence of fusion was noted at the 3-month postoperative office visit.
Case Discussion

This case demonstrates a classic case of cervical radiculopathy with kyphosis well treated with a 2-level arthrodesis. In the face of cervical spondylosis and kyphosis, a motion sparing device may allow recurrence or retention of spondylosis and clinical failure. Dr. Weinstein points out many of the theoretical advantages of a dynamized plate in this gold standard treatment. We have also demonstrated the fusion advantages of dynamization in this approach. (1) The message here is to retain all these options and to pick the right option for the right patient.

Case 3 (C-Spine)

Author's Response

The use of dynamic cervical plates has its roots in basic bone biology. Bone heals best under compressive loads as first described by Wolff. Static anterior plates shield the bone graft and absorb much of the stress across the disc space. Dynamic plates allow the stress to be transferred and shared by the interbody graft and provide the optimal biomechanical environment for successful spinal fusion.
Case 3 (C-Spine)

Author's Response

Initial osteoclastic reaction results in early graft resorption prior to osteoblastic response allowing for fusion. It is this initial resorption that causes increased plate stress in the static plate. Historically, early static plates had a higher rate of failure due to screw and plate breakage and screw pullout which often led to pseudarthrosis.

Dynamic plates may be advantageous as they allow for compression across the interspace particularly during the initial osteoclastic response. This may lead to a high fusion rate (particularly with multilevel surgery) and less instrumentation complications.
Case 3 (C-Spine)

Author's Response

There are currently three categories of dynamic plate design. Translational or sliding plates, rotationally dynamic, and internally dynamic plates each have advantages and disadvantages. The translational plates typically are designed with oval holes in which the screws are initially seated toward the edge of the plate and allow for compression through the plate hole. The plates may have one or more pairs of oval holes.

The advantages are simple design and good fixation of screw to bone. A major disadvantage is that the position of the plate in relation to the adjacent disc changes with compression of the intervertebral graft. As compression occurs the ends of the plate get closer to the adjacent disc. Recent studies have shown a greater incidence of adjacent level disease when the plate is less than 5-mm from the adjacent disc space. (1)
Case 3 (C-Spine)

Author's Response

Rotationally dynamic plates are typical of many plates in current use. The screws are seated in the bone but may change angle to allow dynamization. The advantages of these plates are that the instrumentation and implantation techniques are familiar to most surgeons and off-axis placement has little effect on the ability of the device to allow compression. The disadvantage of this type of plate is that as the plate-screw angle is altered the screws must loosen at least some degree to allow for dynamization to occur. This is because a change in the plate-screw angle must result in some lifting of the plate off the vertebrae or toggle of the bone-screw interface.
Author's Response

Internally dynamized plates may provide the best option for cervical graft compression and load-sharing. These plates are designed to allow compression through a unique mechanism with the plate itself. This allows the screws and the plate to be fixed in position on the anterior cervical spine before, during and after graft compression. While these plates are slightly more technically demanding to apply, the end result is a load-sharing device design that allows a prespecified amount of settling (typically 2mm) without any migration of the plate toward the adjacent healthy disc. The screws are also securely fixed to bone with less risk of loosening compared to the rotationally dynamic plates.

Lumbar Spine

Cases
Lumbar Case

Case 1
History

• 29-year-old male with insidious onset of back pain traveling to the right leg about 6 months ago
• Starts at the right lumbosacral junction and goes into the right buttock, the posterior thigh and the posterior right calf
• Tingling/numbness along the posterior aspect of the right lower leg distal to the knee
History

• Symptoms intensify with sitting and valsalva
• He has an hour long drive to get to work and this is getting really difficult for him
• Pain also intensifies with bending and he usually feels better when he is walking
• Symptoms are gradually getting worse
Time to Share…

• What are your thoughts on the case history?
• What are you looking for in the physical exam?
Physical exam

• Gait, coordination and motor tone is normal
• Sensation and motor strength are normal
• Reflexes are 2+ at the biceps, triceps, knees and ankles
• There are a few beats of clonus emanating from the right foot, none from the left
Physical exam

• Range of motion of the spine is limited in flexion. He is only able to flex forward to bring his fingers to the knees, this gives him right-sided back pain and pain into the right leg

• Tender to palpation along the right lower lumbar paraspinal musculature and to a lesser degree the right sacroiliac joint
Physical exam

• Range of motion of the peripheral joints is full and there is no joint erythema, swelling, warmth, crepitus, laxity or instability
• Pain with the end range of internal rotation of the right hip and discomfort stretching/palpating the right piriformis
• FABER testing is positive on the right
• Right straight leg raise positive at just 30 degrees, as well as positive cross signs, with pain into the right buttock and posterior thigh
Time to Share...

• What are your thoughts on the physical exam?
• Imaging – what would you order?
• What treatment options would you consider?
Imaging- MR

Right

L4/5
Time to Share...

• What are your thoughts on the x-ray and magnetic resonance images?
• Do the images narrow the treatment options?
• How would you manage this case?
Low Back Pain

Case 2
• 60 y/o male with chronic, non-disabling axial LBP
• Exacerbation after dragging deer 11/22/15 = numb LT leg (no weakness)
• Acute 2 days after snow blowing 12/29/15 (weakness LT LE)
• LBP acute with sitting, wt. bearing: bending and lifting
• Denies fever, chills, or constitutional symptoms
• Denies bowel/bladder paresis
• Significant night pain
History

- No weakness 11/22/15 to 12/29/15; weakness after 12/29/15
- Has radiating leg pain bilaterally, LT > RT that goes through the buttocks, down the lat. side of the thigh and calf, onto the outside & top of the foot
- Leg pain worsens with standing and walking; lessens with sitting
Time to Share...

• What are your thoughts regarding the Hx?
• What PE tests would you consider?
Physical exam

• Pain on palpation localizes to the L>R L4-5
• Lumbar motion limited in flexion = extension by pain (w/ no change in leg pain)
• Motor and sensory exam: 4-/5 ankle DF, EHL, Hip abduction; ↓ sensation lat/ant calf/foot
• Positive LT neural tension signs (SLR < Fem)
• Negative FABER bilaterally
Time to Share...

• What are your thoughts re: the physical exam?
• What (if any) imaging are you considering?
• What treatment options would you consider?
Imaging- X-ray (1-9-16)
Imaging - MR (1/9/16)

Left  Midline  Right  

L 4/5  L5/S1
Time to Share...

• What are your thoughts on the x-ray and magnetic resonance images?
• Do the images narrow down the diagnosis and treatment options?
Case Discussion

• Initial 11/22/15 = numb LT leg; 12/29/15 worse
  – Acute by 12/31/15 w/ foot drop ~2 days later
• Bed rest w/ narcotics, mm relaxers, Medrol DP (acute ~2 days)
• MRI & XR 1/9/16
• RTW : 1/11/16 (about 50% capacity)
• 50-80% LBP improvement by 1/26/16 initial surg consult
  – Rx gabapentin to sleep (helped)
  – Wait/watch (max 3 mo.); consider LT L4 neuroforaminal ESI
  – Less LBP but no change in LT foot drop (4-/5 ankle DF)
  – Considering bilat L4 hemilaminectomy & pos. L5 foraminotomy
• Surgery #1: 2/26/16 (d/t Neuro permanency concerns)
  – LT L4 hemilaminectomy
  – Immediate sleep improvement (no Gabapentin needed)
History – UPDATE 4/11/16

- Post-surgical recovery uneventful – walked, stretched
  - Recommended RTW 4-6 wks (returned 3/30/16)
- 61 y/o male with exacerbated LB & LT LE pain 4/11/16 (same S & Sx as late Dec., 2015)
- Severe exacerbation returning to work 1 wk & a trip (overhead bin carry-on)
- Woke up fine after trip; Monday AM over lifted
- LBP acute by next AM with sitting, weight bearing: bending and lifting
- Denies fever, chills, or constitutional symptoms
- Significant night pain – resumed Gabapentin
Time to Share...

• What are your thoughts on the case history?
• What are you looking for in the physical exam?
Physical exam

• Antalgic (flexion & RLF)
• Pain on palpation localizes to the L>R L4-5
• Lumbar motion limited in flexion = extension by pain (no change in leg pain)
• Motor and sensory exam: 4-/5 ankle DF, EHL, Hip abduction; sensation lat/ant calf/foot
• Positive LT neural tension signs (SLR & Fem)
• Negative FABER bilaterally
Time to Share...

• What are your thoughts re: the physical exam?
• What (if any) imaging are you considering?
• What treatment options would you consider?
Imaging- X-ray (4-15-16)

Flexion

Extension
Time to Share...

• What are your thoughts re: the flexion / extension XR?
• What (if any) further imaging are you considering?
• What treatment options would you consider?
44=sacrum, 1=L1
Time to Share...

• What are your thoughts on the x-ray, magnetic resonance?
• Do the images narrow the treatment options?
• Treatment approach?
Case Discussion

• Surgery #2: 4/22/16
• RTW 4hrs/day: 7/22/16
• RTW 6hrs/day: 10/22/16

• FUTURE WORK: ???
Case Options (Don Murphy Case Studies)

1) C-HNP post-CMT managed non-surgically w/ a new CMT approach
2) C-Myelopathy “Near-Miss” (Natural Hx)
3) C-Extension & Sp Cord compression (incl. interesting PE tests and treatment)
4) Cervical Spondylosis w/ Cord compression – incl. a literature review re: preventative surgery for this condition is NOT recommended
5) CMT in presence of Spinal Cord compression (a 29 case series treated w/ CMT – great results!)
6. Non-surgical/Chiropractic treatment of C radiculopathy (impressive outcomes of 30+ pts)
7. Radiculopathy & dermatome inaccuracies – (VERY interesting stats on the relationship between n roots & dermatome)
8. Non-surgical management of HNP (Low back HNP – DC treatment using Clinical Prediction Rule (good)
Case Study

Herniated disc with radiculopathy following cervical manipulation: nonsurgical management

Donald R. Murphy, DC, DACAN*

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Received 1 November 2005; accepted 29 January 2006

Abstract

BACKGROUND CONTEXT: Spinal manipulation applied to the cervical spine is a relatively safe and effective treatment for neck pain and headache. However, complications of this form of treatment have been reported and these can at times be disabling and on rare occasions can be devastating. A postmanipulation complication being treated with a different form of manipulation has not previously been reported.

PURPOSE: To report a case of a patient who was treated with manipulation and who developed neck, scapular, and arm pain and arm numbness after the sixth visit, which was later attributed to three herniated discs. The patient was subsequently treated with a nonsurgical approach that included, but was not limited to, a different form of manipulation with apparent resolution of the problem.

STUDY DESIGN/SETTING: The patient was a 38-year-old banker who began seeing a chiropractic physician for treatment that included cervical manipulation. On the sixth visit, he developed pain immediately after treatment which became severe and was accompanied by numbness in his arm. He saw a neurosurgeon who recommended surgery, but was subsequently seen by a different chiropractic physician and was treated nonsurgically.

METHODS: The patient was found to have clinical signs of radiculopathy, including motor loss. Magnetic resonance imaging revealed disc herniations at C3–C4, C4–C5, and C5–C6.

RESULTS: The patient was treated by the author with an alternate approach that included non–high-velocity, low-amplitude manipulation and exercise with resolution of the problem.

CONCLUSION: This paper reports a case of a patient with radiculopathy secondary to multilevel disc herniations that appeared to be precipitated by cervical manipulation and who was treated nonsurgically with resolution of the problem. It is doubtful that the manipulation actually caused the disc herniations, but it is possible that it caused preexisting asymptomatic disc herniations to become symptomatic. Consideration should be given to nonsurgical referral of patients who have postmanipulative complications but do not need immediate surgery. © 2006 Elsevier Inc. All rights reserved.

Keywords: Complications to manipulation; Cervical disc; Chiropractic; Radiculopathy; Nonsurgical management
CASE REPORT

CERVICAL MYELOPATHY: A CASE REPORT OF A “NEAR-MISS” COMPLICATION TO CERVICAL MANIPULATION

Donald R. Murphy, DC, a,b,c and Jacqueline L. Beres, DC a,d

ABSTRACT

Objective: Cases have been reported in which radiculopathy or myelopathy secondary to herniated disk has occurred after cervical manipulation. In each case, it is not possible to determine whether the neurologic symptoms and signs were directly caused by the manipulation or whether they developed as part of the natural history of the disorder. The purpose of this article is to report a case in which a patient with radiculopathy secondary to herniated disk was scheduled to receive manipulation but just before receiving this treatment developed acute myelopathy.

Clinical Features: A patient with arm pain and numbness was referred by a neurosurgeon for nonsurgical consult. He had a large C5-6 disk herniation with no signs or symptoms of myelopathy. He was determined to be a candidate for nonsurgical intervention, including manipulation. Manipulative treatment was planned for the second visit.

Intervention and Outcome: Ten days after the initial visit, and before any manipulative treatment being rendered, the patient developed symptoms suggestive of myelopathy, which were later determined on examination to be related to acute myelopathy secondary to the disk herniation.

Conclusion: Herniated disk in the cervical spine can progress to myelopathy as part of the natural history of this condition. Because of this, any interpretation of myelopathy that occurs after cervical manipulation, or any other procedure, must be made with caution. (J Manipulative Physiol Ther 2008;31:553-557)

Key Indexing Terms: Intervertebral Disk Displacement; Spinal Cord Diseases; Manipulation, Spinal; Complications, Radiculopathy; Chiropractic; Adverse Effects
Case report

Is treatment in extension contraindicated in the presence of cervical spinal cord compression without myelopathy? A case report

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1. Introduction

Extension of the cervical spine is typically said to cause the lateral canal to decrease in size, thus increasing pressure on the nerve root (Cusick and Yoganandan, 2002) as well as causing a decrease in the sagittal diameter of the central canal (Cusick and Yoganandan, 2002). However, Nuckley et al. (2002) found that while movement of the cervical spine influenced the size of the lateral canal, there was little change in the sagittal diameter of the central canal with any cervical movements. On the other hand, Chen et al. (2003) found that in patients with degenerative changes in the cervical spine, increased encroachment on the spinal cord involves extension (Hughes and Brownell, 1963; Foo, 1986). It is common in the authors’ experience to hear clinicians state that treatments involving extension of the cervical spine in patients with this condition are problematic, if not contraindicated. In fact, some say that any form of manual treatment is contraindicated in patients with disc herniation in general (Rogers et al., 1998). However, it is not known whether these patients are actually at increased risk of myelopathy from extension maneuvers that are performed as part of a therapeutic regimen which carefully monitors symptomatic response.

Recent evidence suggests that the assessment of symptomatic and mechanical responses to end range
Cervical spondylosis with spinal cord encroachment: should preventive surgery be recommended?

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Abstract

Background: It has been stated that individuals who have spondylotic encroachment on the cervical spinal cord without myelopathy are at increased risk of spinal cord injury if they experience minor trauma. Preventive decompression surgery has been recommended for these individuals. The purpose of this paper is to provide the non-surgical spine specialist with information upon which to base advice to patients. The evidence behind claims of increased risk is investigated as well as the evidence regarding the risk of decompression surgery.

Methods: A literature search was conducted on the risk of spinal cord injury in individuals with asymptomatic cord encroachment and the risk and benefit of preventive decompression surgery.

Results: Three studies on the risk of spinal cord injury in this population met the inclusion criteria. All reported increased risk. However, none were prospective cohort studies or case-control studies, so the designs did not allow firm conclusions to be drawn. A number of studies and reviews of the risks and benefits of decompression surgery in patients with cervical myelopathy were found, but no studies were found that addressed surgery in asymptomatic individuals thought to be at risk. The complications of decompression surgery range from transient hoarseness to spinal cord injury, with rates ranging from 0.3% to 60%.

Conclusion: There is insufficient evidence that individuals with spondylotic spinal cord encroachment are at increased risk of spinal cord injury from minor trauma. Prospective cohort or case-control studies are needed to assess this risk. There is no evidence that prophylactic decompression surgery is helpful in this patient population. Decompression surgery appears to be helpful in patients with cervical myelopathy, but the significant risks may outweigh the unknown benefit in asymptomatic individuals. Thus, broad recommendations for decompression surgery in suspected at-risk individuals cannot be made. Recommendations to individual patients must consider possible unique circumstances.
Abstract

Objective: The purpose of this study is to present information from a series of patients with imaging findings of encroachment on the cervical spinal cord who were treated with chiropractic cervical manipulation.

Case Series: There were 27 patients (18 females, 9 males; age range, 23-65, mean age, 44.3 years) with neck and/or arm pain with findings of cervical spinal cord encroachment on magnetic resonance imaging. None of these patients had severe or acute myelopathy or advanced signal changes in the spinal cord indicative of myelomalacia. These patients were treated with a variety of approaches that included some form of cervical manipulation. The mean number of treatments that included manipulation was 12 (range, 2-32). Nineteen patients were treated with high-velocity, low-amplitude “thrust” manipulation, 9 patients were treated with low-velocity muscle energy technique, and 1 patient was treated with both methods. The mean patient-rated subjective improvement at the last follow-up reexamination was 70.0% (range, 10%-100%). From baseline to the last follow-up examination, the mean improvements in outcome measures were as follows: Bournemouth Neck Disability Questionnaire, 23.7 points (31%); Neck Disability Index, 6.4 points; and Numerical Pain Rating Scale, 3.9 points. In 3 patients, there was increased pain after manipulation that lasted from 1 to 4 days. There were no major complications, and in no patient did any increased pain after treatment last more than 4 days. No new neurologic symptoms or signs were seen in any of these patients.

Conclusion: The finding of cervical spinal cord encroachment on magnetic resonance imaging, in and of itself, should not necessarily be considered an absolute contraindication to manipulation. However, because radicular and myelopathic complications to cervical manipulation have been reported in the literature, great care should be taken in all cases, particularly those in which anatomic conditions such as cord encroachment are present. (J Manipulative Physiol Ther 2006;29:236-244)

Key Indexing Terms: Cervical Vertebrae; Manipulation, Spinal; Neck; Spinal Cord Compression; Chiropractic
Cord compression and manipulation

• Murphy & Hurwitz et al., presented a 27 consecutive patient case series

Cord compression and manipulation

(continued)

• Murphy & Hurwitz et al., presented a 27 consecutive patient case series
  – Neck &/or arm pain with clear findings of cervical spinal cord compression on MRI
    • MRI = disc material, osteophytes, ligamentum flavum hypertrophy, or some combination distorted the C-spinal cord or obliterated the CSF; no advanced myelomalacia
  – Ave. # of treatments: 12 (r. 2-32)
    • 18 pts had CMT, 8 pts had low-velocity mm energy techniques, and 1 pt had both types
Cord compression and manipulation (continued)

• Murphy & Hurwitz et al., presented a 27 consecutive patient case series
  – Rate of improvement: 70% (pain & disability: BQ, NDI, NRS)
  – 3 pts had transient ↑ pain lasting 1-4 days but no major complications or new neuro symptoms/signs
  – Care in Dx, CMT set up & careful choice of manual treatments NOT causing peripheralization of pain.

MAKE PTs AWARE OF THIS STUDY when discussing treatment options
Pain patterns and descriptions in patients with radicular pain: Does the pain necessarily follow a specific dermatome?

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Abstract

Background: It is commonly stated that nerve root pain should be expected to follow a specific dermatome and that this information is useful to make the diagnosis of radiculopathy. There is little evidence in the literature that confirms or denies this statement. The purpose of this study is to describe and discuss the diagnostic utility of the distribution of pain in patients with cervical and lumbar radicular pain.

Methods: Pain drawings and descriptions were assessed in consecutive patients diagnosed with cervical or lumbar nerve root pain. These findings were compared with accepted dermatome maps to determine whether they tended to follow along the involved nerve root's dermatome.

Results: Two hundred twenty-six nerve roots in 169 patients were assessed. Overall, pain related to cervical nerve roots was non-dermatomal in over two-thirds (69.7%) of cases. In the lumbar spine, the pain was non-dermatomal in just under two-thirds (64.1%) of cases. The majority of nerve root levels involved non-dermatomal pain patterns except C4 (60.0% dermatomal) and S1 (64.9% dermatomal). The sensitivity (SE) and specificity (SP) for dermatomal pattern of pain are low for all nerve root levels with the exception of the C4 level (SE 0.60, SP 0.72) and S1 level (SE 0.65, SP 0.80), although in the case of the C4 level, the number of subjects was small (n = 5).

Conclusion: In most cases nerve root pain should not be expected to follow along a specific dermatome, and a dermatomal distribution of pain is not a useful historical factor in the diagnosis of radicular pain. The possible exception to this is the S1 nerve root, in which the pain does commonly follow the S1 dermatome.
Abstract

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A Nonsurgical Approach to the Management of Patients With Lumbar Radiculopathy Secondary to Herniated Disk: A Prospective Observational Cohort Study With Follow-Up

Donald R. Murphy, DC, a,b,c Eric L. Hurwitz, DC, PhD, d and Ericka E. McGovern, DC e

Abstract

Objective: This study presents the outcomes of patients with lumbar radiculopathy secondary to disk herniation treated after a diagnosis-based clinical decision rule.

Methods: A prospective observational cohort study was conducted at a multidisciplinary, integrated clinic that includes chiropractic and physical therapy health care services. Data on 49 consecutive patients were collected at baseline, at the end of conservative, nonsurgical treatment and a mean of 14.5 months after cessation of treatment. Disability was measured using the Bournemouth Disability Questionnaire (BDQ) and pain using the Numerical Rating Scale for pain. Fear beliefs were measured with the Fear-Avoidance Beliefs Questionnaire (FABQ). Patients also self-rated improvement.

Results: Mean duration of complaint was 60.5 weeks. Mean self-rated improvement at the end of treatment was 77.5%. Improvement was described as “good” or “excellent” in nearly 90% of patients. Mean percentage improvement on the BDQ was 60.4%. Numerical Rating Scale improved 4.1 points and FABQ improved 4.8 points. Clinically meaningful improvements in pain and disability were seen in 79% and 70% of patients, respectively. Mean number of visits was 13.2. After an average long-term follow-up of 14.5 months, mean self-rated improvement was 81.1%. “Good” or “excellent” improvement was reported by 80% of patients. Mean percentage improvement in BDQ was 67.4%. Numerical Rating Scale improved 4.2 points and FABQ 4.5 points. Clinically meaningful improvements in pain and disability were seen in 79% and 73% of patients, respectively.

Conclusions: Management based on the decision rule yielded favorable outcomes in this cohort study. Improvement appeared to be maintained over the long term. (J Manipulative Physiol Ther 2009;32:723-733)

Key Indexing Terms: Lumbar Region; Radiculopathy; Disk, Herniated; Lumbar Manipulation; Sciatica; Chiropractic; Delivery of Health Care, Integrated
Fig 1. Diagnostic algorithm using the DBCDR.
Fig 2. Management algorithm using the DBCDR.
Table 2. Levels of disk herniation

<table>
<thead>
<tr>
<th>Level</th>
<th>L1-2</th>
<th>L2-3</th>
<th>L3-4</th>
<th>L4-5</th>
<th>L5-S1</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>2</td>
<td>4</td>
<td>10</td>
<td>25</td>
<td>25</td>
</tr>
</tbody>
</table>

Table 3. Outcomes from baseline to end of treatment

<table>
<thead>
<tr>
<th>Variable</th>
<th>Last reexamination</th>
<th>Mean</th>
<th>Median</th>
<th>SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-rated improvement (%)&lt;sup&gt;a&lt;/sup&gt;</td>
<td>77.2</td>
<td>20.6</td>
<td>80</td>
<td>10</td>
<td>10 to 100</td>
</tr>
<tr>
<td>BDQ score&lt;sup&gt;b&lt;/sup&gt;</td>
<td>17.1</td>
<td>14.4</td>
<td>13.5</td>
<td>0</td>
<td>0 to 51</td>
</tr>
<tr>
<td>NRS score&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.0</td>
<td>2.2</td>
<td>3</td>
<td>0</td>
<td>0 to 8</td>
</tr>
<tr>
<td>Change in BDQ&lt;sup&gt;b&lt;/sup&gt;</td>
<td>28.7</td>
<td>18.4</td>
<td>27</td>
<td>-4</td>
<td>-4 to 70</td>
</tr>
<tr>
<td>Change in NRS&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.0</td>
<td>2.7</td>
<td>3.5</td>
<td>0</td>
<td>0 to 9</td>
</tr>
<tr>
<td>% change BDQ&lt;sup&gt;b&lt;/sup&gt;</td>
<td>62.0</td>
<td>68.0</td>
<td>31.0</td>
<td>11.0</td>
<td>100.0</td>
</tr>
<tr>
<td>% change NRS&lt;sup&gt;a&lt;/sup&gt;</td>
<td>62.0</td>
<td>67.0</td>
<td>34.5</td>
<td>-20.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Change FABQ score&lt;sup&gt;c&lt;/sup&gt;</td>
<td>4.8</td>
<td>7.8</td>
<td>4</td>
<td>-12</td>
<td>-12 to 21</td>
</tr>
<tr>
<td>No. of treatments to a DC&lt;sup&gt;d&lt;/sup&gt;</td>
<td>7.7</td>
<td>4.4</td>
<td>7</td>
<td>0</td>
<td>0 to 20</td>
</tr>
<tr>
<td>No. of treatments to a PT&lt;sup&gt;d&lt;/sup&gt;</td>
<td>4.9</td>
<td>5.1</td>
<td>4.5</td>
<td>0</td>
<td>0 to 22</td>
</tr>
</tbody>
</table>

DC, Doctor of chiropractic; PT, physical therapist.
<sup>a</sup> n = 44.
<sup>b</sup> n = 46.
<sup>c</sup> n = 45.
<sup>d</sup> n = 52.

Table 4. Outcomes from baseline to long-term follow-up

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Median</th>
<th>SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-rated improvement (%)&lt;sup&gt;a&lt;/sup&gt;</td>
<td>81.1</td>
<td>22.0</td>
<td>90</td>
<td>10 to 100</td>
</tr>
<tr>
<td>Change in BDQ&lt;sup&gt;a&lt;/sup&gt;</td>
<td>31.0</td>
<td>20.2</td>
<td>30</td>
<td>-7 to 63</td>
</tr>
<tr>
<td>Change in NRS&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.2</td>
<td>2.9</td>
<td>4</td>
<td>-1 to 9</td>
</tr>
<tr>
<td>% change BDQ&lt;sup&gt;a&lt;/sup&gt;</td>
<td>60.4</td>
<td>36.8</td>
<td>85</td>
<td>-11.0 to 100.0</td>
</tr>
<tr>
<td>Change FABQ score&lt;sup&gt;b&lt;/sup&gt;</td>
<td>4.5</td>
<td>9.5</td>
<td>6</td>
<td>-15 to 20</td>
</tr>
</tbody>
</table>

<sup>a</sup> n = 37.
<sup>b</sup> n = 27.

provided in 40 patients (66.6%). Eight patients were referred for epidural steroid injection (ESI).

Data on the main results from baseline to the end of treatment were collected on 46 patients (76.6%). These are presented in Table 3. Mean improvement in BDQ score was 28.7 points (from 45.8 to 17.7). The mean percentage improvement in scores on the BDQ was 62%. This well exceeds the threshold of 47% for clinically meaningful improvement using the BDQ.<sup>29</sup> Using this threshold as the cutoff, clinically meaningful improvement in disability was in 76.5% of patients. Primarily improvement
Disc Regeneration?
Herniated disc (HD), one of the major causes of low back pain, is often resolved spontaneously without surgical intervention. Resorption is associated with a marked increase in infiltrating macrophages, and the matrix metalloproteinases (MMP) MMP-3 and MMP-7 have been implicated in this phenomenon. We developed a murine organ culture model in which intact intervertebral discs were cocultured with peritoneal macrophages to investigate the role of MMPs in HD resorption. Using macrophages isolated from MMP-null mice, we report that macrophage-produced MMP-7 was required for proteoglycan degradation, loss of wet weight, and macrophage infiltration of cocultured discs. The inability of MMP-7–deficient macrophages to infiltrate discs could not be attributed to a defect in macrophage migration. MMP-7 was required for the release of the cytokine TNF-a from peritoneal macrophages. The generation of soluble TNF-a was essential for the induction of MMP-3 in disc cocultures, which in turn is required for the generation of a macrophage chemoattractant and subsequent macrophage infiltration. TNF-a release from macrophages was necessary but insufficient for disc resorption, which required macrophage infiltration. We conclude that there is extensive communication between macrophages and chondrocytes in HD resorption and that an essential component of this communication is the requirement for MMPs to release soluble bioactive factors.


• **ABSTRACT SUMMARY:**
  • L-HNP commonly occur in 20-40yo acutely = LB & LE pain
  • Good prognosis: 70% sciatica-free at ~6 mo.
  • MRI reveal spontaneous absorption
  • Inflammatory cytokines (TNF-a) + angiogenic factors (blood/macrophages) + enzymes (matrix metalloproteinases – MMP-7)
  • Injected into the IVD = efficacious & no side effects vs. surgery
  • Currently phase 1 of 2 studies are ongoing in the U.S.
  • Pts w/ L-HNP may benefit (less invasive & can be applied immediately after the onset
2014 – Injectable?

Fig. 1 Sequential magnetic resonance imaging of a 66 year-old man demonstrating resorption of the herniated disc
Mohawk promotes the maintenance and regeneration of the outer annulus fibrosus of intervertebral discs

Ryo Nakamichi1,2, Yoshiaki Ito1, Masafumi Inui3, Naoko Onizuka3, Tomohiro Kayama1, Kensuke Kataoka1, Hidetsugu Suzuki1, Masaki Mori1, Masayo Inagawa3, Shizuko Ichinose4, Martin K. Lotz5, Daisuke Sakai6, Koichi Masuda7, Toshifumi Ozaki2 & Hiroshi Asahara1,3,5,8
Mohawk promotes the maintenance and regeneration of the outer annulus fibrosus of intervertebral discs

Ryo Nakamichi1,2, Yoshiaki Ito1, Masafumi Inui3, Naoko Onizuka3, Tomohiro Kayama1, Kensuke Kataoka1, Hidetsugu Suzuki1, Masaki Mori1, Masayo Inagawa3, Shizuko Ichinose4, Martin K. Lotz5, Daisuke Sakai6, Koichi Masuda7, Toshifumi Ozaki2 & Hiroshi Asahara1,3,5,8

The main pathogenesis of intervertebral disc (IVD) herniation involves disruption of the annulus fibrosus (AF) caused by ageing or excessive mechanical stress and the resulting prolapse of the nucleus pulposus. Owing to the avascular nature of the IVD and lack of understanding the mechanisms that maintain the IVD, current therapies do not lead to tissue regeneration. **Here we show that homeobox protein Mohawk (Mkx) is a key transcription factor that regulates AF development, maintenance and regeneration.** Mkx is mainly expressed in the outer AF (OAF) of humans and mice. In Mkx/ mice, the OAF displays a deficiency of multiple tendon/ligament-related genes, a smaller OAF collagen fibril diameter and a more rapid progression of IVD degeneration compared with the wild type. Mesenchymal stem cells overexpressing Mkx promote functional AF regeneration in a mouse AF defect model, with abundant collagen fibril formation. **Our results indicate a therapeutic strategy for AF regeneration.**
Disc Regeneration?


Decellularized allogeneic intervertebral disc: natural biomaterials for regenerating disc degeneration
Xianfeng Lin1,2,* , Xiangqian Fang1,2,* , Qiang Wang1,2,* , Zhijun Hu1,2, Kai Chen3, Zhi Shan1, Shuai Chen1,2, Jiying Wang1,2, Jian Mo1,2, Jianjun Ma1,2, Wenbing Xu1,2, An Qin4 and Shunwu Fan1,2; 1 Department of Orthopaedic Surgery,

Disc Regeneration? (2)

ABSTRACT
Intervertebral disc degeneration is associated with back pain and disc herniation. This study established a modified protocol for intervertebral disc (IVD) decellularization and prepared its extracellular matrix (ECM). By culturing mesenchymal stem cells (MSCs) (3, 7, 14 and 21 days) and human degenerative IVD cells (7 days) in the ECM, implanting it subcutaneously in rabbit and injecting ECM microparticles into degenerative disc, the biological safety and efficacy of decellularized IVD was evaluated both in vitro and in vivo. Here, we demonstrated that cellular components can be removed completely after decellularization and maximally retain the structure and biomechanics of native IVD. We revealed that allogeneic ECM did not evoke any apparent inflammatory reaction in vivo and no cytotoxicity was found in vitro. Moreover, IVD ECM can induce differentiation of MSCs into IVD-like cells in vitro. Furthermore, allogeneic ECM microparticles are effective on the treatment of rabbit disc degeneration in vivo. In conclusion, our study developed an optimized method for IVD decellularization and we proved decellularized IVD is safe and effective for the treatment of degenerated disc diseases.
Disc Regeneration?

WOW!!!
Surgical Versus Nonoperative Treatment for Lumbar Disc Herniation: Eight-Year Results for the Spine Patient Outcomes Research Trial

Lurie, Jon D, MD, MS; Tosteson, Tor D, ScD; Tosteson, Anna N. A, ScD; Zhao, Wenyan PhD; Morgan, Tamara S, MA; Abdu, William A, MD, MS; Herkowitz, Harry MD; Weinstein, James N, DO, MS

Abstract

Study Design. Concurrent prospective randomized and observational cohort studies.

Objective. To assess the 8-year outcomes of surgery versus nonoperative care.

Summary of Background Data. Although randomized trials have demonstrated small short-term differences in favor of surgery, long-term outcomes comparing surgical with nonoperative treatment remain controversial.

Methods. Surgical candidates with imaging-confirmed lumbar intervertebral disc herniation meeting Spine Patient Outcomes Research Trial eligibility criteria enrolled into prospective randomized (501 participants) and observational cohorts (743 participants) at 13 spine clinics in 11 US states. Interventions were standard open discectomy versus usual nonoperative care. Main outcome measures were changes from baseline in the SF-36 Bodily Pain and Physical Function scales and the modified Oswestry Disability Index-AAOS/Modems version assessed at 6 weeks, 3 months, and 6 months, and annually thereafter.

Results. Advantages were seen for surgery in intent-to-treat analyses for the randomized cohort for all primary and secondary outcomes other than work status; however, with extensive nonadherence to treatment assignment (49% patients assigned to nonoperative therapy receiving surgery versus 60% of patients assigned to surgery) these observed effects were relatively small and not statistically significant for primary outcomes (bodily pain, physical function, Oswestry Disability Index). Importantly, the overall comparison of secondary outcomes was significantly greater with surgery in the intent-to-treat analysis (sciatica bothersomeness [P > 0.005], satisfaction with symptoms [P > 0.013], and self-rated improvement [P > 0.013]) in long-term follow-up. An as-treated analysis showed significant surgical treatment effects for primary outcome measures (mean change, surgery versus nonoperative care; treatment effect: 95% confidence interval): bodily pain (45.3 vs. 34.4, 10.9; 7.7 to 14), PF (42.2 vs. 31.5, 10.6; 7.7 to 13.5), and Oswestry Disability Index (–36.2 vs. –24.8; –11.3; –13.6 to 9.1).

Conclusion. Carefully selected patients who underwent surgery for a lumbar disc herniation achieved greater improvement than nonoperatively treated patients; there was little to no degradation of outcomes in either group (operative and nonoperative) from 4 to 8 years.

Level of Evidence: 2
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TRACTION
**Traction (Tx)**

Definition: the act of pulling a body part

**Types of Traction**

1. Axial Tx - along the long axis of body
2. Weight Tx - forces produced by weights
3. Elastic Tx - elastic bands or tubes; provides progressive resistance
4. Head or lumbopelvic
5. Extremity traction
Directions of Pull

- Horizontal patient position (most common - can modify)
- Vertical patient position
- Inverted patient position
Physiological Goals

1. Separate or stretch joint surfaces
2. Reduce muscle spasm (continuous Tx)
3. Reduce swelling (Intermittent Tx); provides pumping action
4. Stretch scar tissue/break-up adhesions (both)
5. Triggers joint receptors/reflexes (both)
6. Temporary immobilization (continuous Tx)
Mechanical Continuous Traction

- **Treatment duration** - minutes to hours (usually 15-30 minutes)
- **Physiological effects** -
  - Immobilize tissue
  - Relaxes muscle
  - Relieves compressed joints
  - Stimulates proprioception
  - Stretches scar tissue
  - May facilitate disc conditions
  - Reduces pinched nerve effects
Mechanical Intermittent Traction

- **Treatment duration** - 15-30 minutes
- **Physiological effects** -
  - Improves circulation
  - Reduces swelling
  - Improves muscle tone
  - Stretches scar tissue
  - Promotes hydration of a disc (IVD)
  - Stimulates proprioception
Manual Traction

- Applied by use of the hands
- May use a steady, intermittent, or combinations of pulling forces

Positional Traction

- Use of pillows, sandbags, rolls, and blocks
- Uses gravity
Gravity Inversion

- Suspended either upright or upside down
- Various angles can be achieved in some units
- Can be sustained or intermittent
- Can be performed in lumbar flexion (forward first-waist over bar type) or extension (hang by ankles, back first on rotating bed)

- CONTRAINDICATED: high blood pressure, glaucoma, stroke history
Cervical - For C3-7, head flexion of 25-30 degrees; For occiput-C2, 0 degrees of flexion
Lumbar (prone) - Flexion is determined by abdominal pillow size
Lumbar (supine) - Supine with knees flexed
• Dependent on:
  » Specific condition being treated
  » Physical status of the patient
  » Patient tolerance

• Intermittent Tx- maximum 30, usual 10-15 minutes

• Sustained Tx- 15-30 minutes average, max hour
Rules

1. Choose proper patient position (use pillow, pads, rolls, etc.)
2. Pad soft and hard tissues (especially if heavy weights are used)
3. Apply traction slowly
4. Don’t traction too long (work up to desired goal gradually)
5. Monitor patient’s comfort (give “kill” switch)
6. Hot, cold, manipulation, massage may be simultaneously applied
Reeducibility of Cervical Disk Herniation: Evaluation at MR Imaging during Cervical Traction with a Nonmagnetic Traction Device

The authors evaluated the reducibility of cervical disk herniation at magnetic resonance (MR) imaging performed with the patient in cervical traction. After the acquisition of neutral-state images, cervical traction images were obtained in 29 patients and seven healthy volunteers while they wore a portable intermittent traction device. During traction, all volunteers and 21 patients had a substantial increase in the length of the cervical vertebral column. The disk herniation was completely resolved in three patients and partially reduced in 18. The reducibility of cervical disk herniation can be evaluated at MR imaging performed during cervical traction.

very helpful for evaluating the reducibility of disk herniation during traction, and magnetic resonance (MR) imaging is the best examination for evaluation of intervertebral disk problems. To our knowledge, however, a device that enables visualization of the cervical disk during traction and is applicable to MR imaging has not been available before now. Although a portable traction device for cervical fractures has been reported on, the report was in the form of a technical note regarding a portable traction device that can be used with myelography or computed tomography (CT) (8). The study was not applicable to MR imaging because the metallic composition of the described traction device produced substantial artifacts.

We have designed a portable intermittent traction device made of nonmagnetic materials that do not affect MR imaging. The purpose of our study was to evaluate the reducibility of cervical disk herniation at MR imaging performed with the patient in cervical traction.

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SUMMARY:

• Can C-Traction reduces C-HNP?
• 29 patients vs. 7 healthy controls
• Portable intermittent traction device
• ALL 7 controls & 21 of 29 pts had a substantial increase in C-spine length.
• C-HNP completely resolved in 3 of 29 patients & partially in 18/29.
• C-HNP reducibility can be evaluated by MRI performed during C-traction.
weakness, sensory deficits, or muscular signs such as decreased range of motion or point tenderness. Next, the selected volunteers underwent T2-weighted MR imaging while in a neutral (ie, nontraction) state, and if either a degenerative change in or a herniation of a disk was detected, the subject was excluded. Finally, the selected volunteers underwent MR imaging while wearing the inflated traction device.

The patient group consisted of 10 men and 19 women, who ranged in age from 25 to 62 years (mean age, 44.4 years). The healthy volunteer group consisted of one man and six women, who ranged in age from 19 to 37 years (mean age, 26 years). The MR imaging examinations were performed after informed consent had been obtained from all patients and volunteers, as was required by the institutional review board of Yonsei University College of Medicine, YongDong Severance Hospital.

Traction Device

The traction device (Fig 1) was originally designed for portable intermittent use to accommodate a patient’s daily activities during traction. It is also constructed of a nonmagnetic material (Airtrac 101; Airtrac MSL, Seoul, Korea) that is compatible to MR imaging units. The traction device consists of three main parts: (a) a shoulder cover for the base of the device, (b) an accordion-shaped middle component that can be expanded by means of air inflation, and (c) mandible supports for effective transmission of traction. When the device is inflated with air, the accordion-shaped middle component stretches and has a traction effect on the neck. The anterior portion of the middle component is inflated with air, through which a chest compression belt is passed, as well as the posterior portion of the middle component.
Figure 3. (a, b) Sagittal (4,000/128) and (c, d) transverse (two-dimensional fast low-angle shot sequence, 550/12, 30° flip angle) MR images depict a completely resolved cervical disk herniation after traction. (a, c) Neutral-state MR images show extrinsic compression of the dural sac and spinal cord at the C5-6 cervical disk level due to an HCD (arrow). (b, d) Traction-state MR images show reduction of the cervical disk herniation and the residual deformed spinal cord. Widening of the right-side facet joint space (arrow in d) is seen on the transverse traction-state image.

\[
\frac{(D - d)}{D} \times 100.
\]

\(D\) is the distance between two parallel lines—one line drawn at the base of the herniated disk particle and the other drawn at the tip—in the neutral state, and \(d\) is this distance in the traction state.

terior landmark because exact localization of the odontoid process tip could have been difficult sometimes owing to a patient's tilting or rapid position change during traction. Measurements of cervical vertebral column elongation were obtained by two neuroradiologists (T.S.C., Y.J.L.) separately and blindly. The neuroradiologists were not informed of the patients' clinical information.

The reducibility of cervical disk herniation was evaluated in the patient group. Complete resolution of the herniation was defined as a result in which the disk was completely inside the annulus margin without a residual herniated disk particle. Partial reduction was defined as a more than 50% volume reduction in the herniated disk particle with some residual tissue. The reduction ratio was calculated as follows: \([(D - d)/D] \times 100\), where \(D\) is the distance between two parallel lines—one line drawn at the base of the herniated disk particle and the other drawn at the tip—in the neutral state and \(d\) is this distance in the traction state (Fig 2).

Whether there was widening of the facet joints or intervertebral foramen during traction was determined in the patients and healthy volunteers. Retraction of the posterior margin of the disk during traction, as depicted on sagittal MR images, also was evaluated in the volunteers and patients. If the retracted posterior margin of the disk passed an imaginary line drawn along the anterior rim of the foramen, its retraction was considered to be significant.
TABLE 1
Increased Length of Cervical Vertebral Column during Traction

<table>
<thead>
<tr>
<th>Column Elongation</th>
<th>Volunteers (n = 7)</th>
<th>Patients (n = 29)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of Subjects</td>
<td>Elongation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Length (mm)*</td>
</tr>
<tr>
<td>Substantially increased</td>
<td>7</td>
<td>1.93</td>
</tr>
<tr>
<td>length</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimally increased</td>
<td>0</td>
<td>...</td>
</tr>
<tr>
<td>length</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Data are mean lengths of elongation of the cervical vertebral column.
† Length of elongation not significantly different from that in healthy volunteers (P = .971).
‡ Significantly shorter length of elongation compared with that in healthy volunteers (P < .001).

Figure 2. Measurement of reduction ratio. Reduction ratio was calculated as follows: \([D - d]/D \times 100\). \(D\) is the distance between two parallel lines—one line drawn at the base of the herniated disk particle and the other drawn at the tip—in the neutral state, and \(d\) is this distance in the traction state.

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Figure 4. (a, b) Sagittal (4,000/128) and (c, d) transverse (two-dimensional fast low-angle shot sequence, 550/12, 30° flip angle) MR images of a partially reduced cervical disk herniation after traction. (a, c) Neutral-state MR images show a small area of high signal intensity (arrow) that corresponds to a herniated disk fragment in the posterior central direction at the C5-6 cervical disk level. (b, d) Traction-state MR images show a reduction of the fragment (arrow in b) through a torn tract of the annulus fibrosus at the C5-6 cervical disk level.
Figure 5. Sagittal T2-weighted MR images (4,000/128) of the foramen at the C6-7 cervical disk level and the facet joint at the C7-T1 cervical disk level in a patient with HCD in (a) neutral and (b) traction states. The facet joint (arrow) is widened at traction (b) compared with in the neutral state (a). The width of the foramen (arrowheads) also increased with traction.
Figure 6. Sagittal T2-weighted MR images (4,000/128) of the cervical spine of a healthy volunteer in (a) neutral and (b) traction states. Dimpling of the annulus capsule (arrow in b) is seen at traction.
<table>
<thead>
<tr>
<th>Spinal Column Change</th>
<th>No. of Volunteers (n = 7)</th>
<th>No. of Patients (n = 29)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annulus capsule dimpling</td>
<td>3 (43)</td>
<td>12 (41)</td>
</tr>
<tr>
<td>Facet joint space widening</td>
<td>2 (29)</td>
<td>5 (17)</td>
</tr>
<tr>
<td>Intervertebral foraminal widening</td>
<td>1 (14)</td>
<td>5 (17)</td>
</tr>
</tbody>
</table>

Note.—Numbers in parentheses are percentages.
Weight Poundage

- **Cervical (sustained) Tx:** For over-the-door cervical traction units, start at 2-4lbs and gradually increase (max 10-13lbs); comfort **must** be the guide
- **Cervical (intermittent) Tx:** 5% body weight (usual range 5-20lbs)
- **Lumbar Tx:** 25-50% body weight (max 120 lbs)

General Rules

- The longer the treatment, the less weight is tolerated
- **ALWAYS** respect the patients tolerance (reduce or discontinue weights if patient complains)
Disc Decompression
Quantitative Functional Capacity Evaluation (QFCE)

- Based on normative data
- Test for physical performance - function
- Rehabilitative prescription
- Returning the patient to work
- Assessing a true functional outcome
Exercise Screen/QFCE

- Pre- and post VAS
- 7 Strength and endurance screens
- 6 Muscle length screens
- 5 Non-organic signs (Waddell LB)
- Spinal ROM (inclinometer - LB & C)
- Proprioception screens
- Aerobic screen
- Total of 23 physical performance screens / 40 min.)

97750 Physical performance test or measurement (ea. 15 min.)
See QFCE Manual/DVD for distance learning option
C-Spine QFCE Tests

TEST #14  CERVICAL INCLINOMETER SPINAL RANGE OF MOTION

*NORMALS (3):

<table>
<thead>
<tr>
<th>MOTION</th>
<th>MEAN AND SD</th>
<th>PERCENT OF NORMAL</th>
<th>NORMAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexion</td>
<td>53 +/- 12.1</td>
<td>103.6</td>
<td>50*</td>
</tr>
<tr>
<td>Extension</td>
<td>71 +/- 14.1</td>
<td>112.6</td>
<td>63*</td>
</tr>
<tr>
<td>Right Lateral Flexion</td>
<td>49 +/- 7.2</td>
<td>109.6</td>
<td>45*</td>
</tr>
<tr>
<td>Left Lateral Flexion</td>
<td>50 +/- 7.8</td>
<td>112.0</td>
<td>45*</td>
</tr>
<tr>
<td>Right Rotation</td>
<td>88 +/- 10.6</td>
<td>103.3</td>
<td>85*</td>
</tr>
<tr>
<td>Left Rotation</td>
<td>90 +/- 9.6</td>
<td>105.5</td>
<td>85*</td>
</tr>
</tbody>
</table>

* Taken of 160 male railroad workers: Ave. age 35 yrs (+/- 7.5); Ht 64.9 in. (+/- 2.6); Wt. 187 (+/- 28.6) lbs. (3)

Calculation method: Pt Result / Normal from Table x 100 = _______%

Example: Ri Rot. = 47°; 47 / 85 x 100 = 55% (transfer to Form: QFCE Results pg 27)

15b. Static Neck Endurance Test (SNET)

Use the width of a typical ruler to establish the 1-inch off the bench starting position. Start the time when the patient supports the weight of the head off the bench 1-inch, just off the ruler. Record the time when the head first touches the bench.

Stop the test / time when the head hits the ruler. If the patient increases the distance off the bench > 1 inch as they fatigue, instruct them not to lift their head further off the bench.

Patient Position: Supine

References (Normative data and validation studies)

- Yeomans, S. Quantitative Functional Capacity Evaluation, 2nd Edition. 2000. Contact: sgyeomansdc@gmail.com or, 920-748-3644
Screen 15: Cervical Spine Endurance

Nexerciser Option

15b. Vernon, 1992 (norms available – page 334, Ch 16 text)
ACTIVE CARE OPTIONS

TEST 3
L-ROM TEST
EXERCISE OPTIONS FOR THE EXTENSION-BASED PATIENT

1. Standing extension
2. Chair extension
3. Push-up
4. Chest on floor extension
5. Straight leg extension
6. Prone Gluteal Extension
7a. Hand-heel-rock - step 1
7b. Hand-heel-rock - step 2
7c. Hand-heel-rock - step 1
7d. Hand-heel-rock - step 2
8a. Side Glides Left
8b. Side Glides Right

Objective: Improve knee and centralizes peripheral leg pain.

NAME ___________________________ DATE ___________________________

Exercise Directions:

Exercise 2-6 can be applied many times a day for up to 3-6 minute holds, rather than in reps.

Exercise 7, the Hand-heel Rock (7a-7d) where slow reps are preferred. The flexion component of the hip should be modified during the peripheralization period of the patient's condition, especially if pain radiates into a leg during step 2 (7b). Often, waiting until peripheral symptoms are eliminated before starting the hip is wise.

Exercise 8, side gliding is used when spinal stability exists, unlike the side that centralizes pain.

Modifying individual patient. Discontinue if sharp or shooting pain occurs and persists.

TEST 3
L-ROM TEST
EXERCISE OPTIONS FOR THE FLEXION-BASED PATIENT

1. Single Leg Lift-couch
2. Double Leg Lift-couch
3. Posterior Pelvis tucks
4. Single Leg "hugause"
5. Hamstring #3 push
6. Hamstring #2
7a. Sit-backs - start
7b. Sit-backs - 10 sec hold
8. Psoas stretch

Exercise Directions:

1-3 & 5, 10, 11 - 10s; 3x holds to tolerance
5. Push & squat to max., then hold 2 min / leg OR
6. 1x alternate legs @ 10 sec. hold with contraction
7a. Hold sit-back (10) 10 reps. (progress by starting on the back and bending head and shoulder blades off floor)
9. Hold 30 sec or as long as desired (quads & glutes burn)
11. Keep shoulders on floor and rotate knees to own side.

If “bad” (vs. “good”) pain occurs, STOP & move on to the next exercise. Repeat those AM & PM, or more.

NAME ___________________________ DATE ___________________________

Pelvic & Trunk Stabilization Exercises – Gym Ball

1. Pelvic Tilts (3 min.): Level I (a-c) – Ant. & Post. Pelv tilt slowly; Level II Post. Pelv Tilt with a March; Level III = March with roll back

2. Bridge (3 min. ea. Level): Level I (a & b) = roll back & forth into bridge (push heels into floor (lib); Level II = 1.2 sit-back with a march; Level III = hold extended leg & alternate at 10 sec. each.

Ia  Ib  Ic  II  III

4. Bridge (3 min. ea. Level): Level I – bridge (push heels into floor); Level II – Bridge w/march; Level III – hold extended leg & opposite arm alternate at 10 sec. each.

I  II & III

5. Horizontal Side Bridge: Level I – 6 sec. from knees; Level II – 6 sec. from feet; Level III – 12 sec. from feet

I  II  III

Objective: Improve strength and coordination of the abdominal/core muscles & promote flexion.
Exercise Directions

Exercises 1-6 can be applied many times a day for up to 5-6 minute holds, rather than in reps.

Exercise 7, the Hand-heel Rock (7a-d) where slow reps are preferred. The flexion component of the HHR (7b) should be modified during the peripheralization period of the patient’s condition, especially if pain radiates into a leg during Step 2 (7b). Often, waiting until peripheral symptoms are eliminated before starting the HHR is wise.

Exercise 8, side gliding is used when spinal antalgia exists- utilize the side that centralizes pain. Modify to each individual patient. Discontinue if sharp or alarming pain occurs and discuss.

Objective: Improve ROM and centralize peripheral/leg pain.

NAME ___________________________ DATE ____________________
EXERCISE OPTIONS FOR strengthening the paraspinal cervical muscles

1a) Apply pressure through the ROM
1b) First, move the head in the direction of the hand (concentric contraction)
1c) Continue this in all 4 directions of motion
1d) Second, keep pressure against the hand but allow the hand to over pressure the head/neck
1e) This produces an eccentric contraction

1f) Therefore, 1a-f will be performed 2x. (concentric & eccentric contractions)
2a) Apply isometric pressure against the beach ball within tolerance
2b) Repeat this in all 4 directions
2c) Do at various points in the ROM (not only neutral as shown)
2d) Try to simulate a movement (isotonic) by moving away & towards the ball

NAME ___________________________________________ DATE __________________
EXERCISE OPTIONS FOR ABNORMAL CERVICAL SPINE ROM &/OR STRENGTH
Pushing, pulling, lifting, carrying, and torsional exertion are compromised when the spine bends causing “energy leaks”.

“Core stability” training has been shown to be effective for both preventing and rehabilitating shoulders and knees.

SEE HANDOUTS!

https://www.nsca.com/uploadedFiles/NSCA/Resources/PDF/Education/Articles/NSCA_Classics_PDFs/Core%20Training%20Evidence%20Translating%20to%20Better.pdf
Core Training: Evidence Translating to Better Performance and Injury Prevention

Figure 1. (a) Poor standing posture causes constant spine load and chronic contracture of the erector spinae muscles causing muscular pain. (b) One approach for correction is to externally rotate the arms about the shoulders (steering the thumbs out). (c) Correcting the posture with chin and shoulder retraction reduces the chronic muscle contraction reducing pain and building training capacity.

SEE HANDOUTS!
Lunging with the arm directed overhead helps to differentiate and target psoas from iliacus during hip flexor stretching. Hip extensor patterns are simultaneously trained on the opposite side of the body. When this exercise is performed as walking steps, holding the posture for 2 seconds and pulsing the arm upward through the core, then taking a step and repeating, it becomes a facilitator and a good “warm-up” exercise.

SEE HANDOUTS!
Core Training: Evidence Translating to Better Performance and Injury Prevention


SEE HANDOUTS!

Figure 3. An example of provocative testing. The patient compresses the spine by grabbing the side edges of the seat and pulling up. When doing this with an upright back (a), the torso is stiffened with muscle activity. The test is then repeated in a slouched posture (b); discomfort in this position as compared with an upright back shows a lower tolerance when the spine is flexed (and a flexion intolerant patient). This reveals where the spine tolerance is highest, and therefore, a posture to begin therapeutic exercise (i.e., no spine flexion).

https://www.nsca.com/uploadedFiles/NSCA/Resources/PDF/Education/Articles/NSCA_Classics_PDFs/Core%20Training%20Evidence%20Translating%20to%20Better.pdf
Core Training: Evidence Translating to Better Performance and Injury Prevention


Figure 4. (a) Curl-up over a gym ball motions stresses the discs, mimics a potent disc injury mechanism, and unwisely uses pain-free training capacity. (b) The “stir the pot” exercise spares the painful discs of motion and builds abdominal athleticism.

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DESIGNING STAGED CORE EXERCISE—BIOMECHANICS AND CLINICAL PRACTICE

Exercise progression is a staged process. Several sources are available (30,40) that expand on the many considerations and techniques to hone clinical skills at each stage some of which are listed below:


Stages of progressive exercise design:

1. Corrective and therapeutic exercise
2. Groove appropriate and perfect motion and motor patterns
3. Build whole-body and joint stability (mobility at some joints such as the hips and stability through the lumbar/core region)
4. Increase endurance
   For occupational/athletic clients:
5. Build strength
6. Develop speed, power, and agility

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ABSTRACT.

Objective: To quantify several forms of the curl-up, side-bridge, and birddog exercises (muscle activity and 3-dimensional [3D] spine position) including some corrective techniques to assist clinical decision-making.

Design: A basic science study of a convenience sample with a retest of expert intervention.

Setting: Spine Biomechanics Laboratory/Research Clinic.

Participants: Healthy men (N=8) performed the exercises, and 5 subjects repeated the exercises as an expert applied corrective techniques.

Interventions: Not applicable.

Main Outcome Measures: Surface electromyography of selected trunk and hip muscles together with video analysis and 3D spine posture were collected.

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http://www.archives-pmr.org/article/S0003-9993(08)01505-0/pdf

ABSTRACT.

Results: Comparison of muscle activation levels showed there were justifiable progressions in each exercise form. In general, bracing of the abdominal wall enhanced activation of the obliques, but different techniques caused migration of muscle activity to other muscles. Examples of specific findings include the following. Movement during these traditionally isometric exercises such as drawing squares with the hand/foot while in the birddog posture enhances activation of many muscle groups. Breathing while holding the isometric exercises had differing effects on muscle activation which was exercise dependent. Some corrective exercise techniques, such as fascial raking, substantially changed relative activation between muscles in the abdominal wall.

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ABSTRACT.

Conclusions: The data presented in this study may be used to guide the clinical decision process when choosing a specific exercise form together with selecting the correct starting level, a logical progression, suitable dosage, and possible corrective technique to enhance tolerance of a patient.

Key Words: Clinical laboratory techniques; Exercise; Rehabilitation.

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http://www.archives-pmr.org/article/S0003-9993(08)01505-0/pdf
Hold: 5 sec.  
Progression (B): 1) Lift elbows, 2) Abd Brace, 3) Breath deeply

**FACILITATION:**
Careful NOT to encroach on the rectus!

**Fig 2.** Raking of the fascia with 2 hands. Note that stimulation is to the obliques and not the rectus.

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Fig 3. Illustration of rapid contraction, plyometric dead bug: (A) Relaxed, (B) large amplitude slow motion, and (C) short range (see arrows).

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**Fig 3. Illustration of rapid contraction, plyometric dead bug. (A) Relaxed, (B) large amplitude slow motion, and (C) short range (see arrows).**

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Fig 3. Illustration of rapid contraction, plyometric dead bug. (A) Relaxed, (B) large amplitude slow motion, and (C) short range (see arrows).

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1) Place RT hand under the lumbar spine. Start w/ hips, knees, & shoulders flexed 90°
2) SLOWLY extend RT hip/LT shoulder until completely extended, JUST OFF the floor (C)
3) HOLD 5 seconds.
4) RETURN TO 90/90/90 and repeat on opposite side.

NOT SHOWN: In position “C” – rapidly flex the RT hip/LT shoulder (keep torso stiff) = progression of exercise OPTION.
A. LT elbow under GH joint, RT hand stabilizes LT shoulder
B. RT hand stabilizes waist.
C/D. From Feet

PROGRESSION: Add SLOW deep breathing
(SEE next slide for the final progression; alter “HOLD” times further challenging the patient)

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Fig 5. Illustration of the (A) left side-bridge, (B) roll to plank, and (C) rolling from the plank to right side-bridge (this photo captures the roll midway). Note that the ribcage is locked to the pelvis, resulting in minimal spine twist.

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1) NOT SHOWN: Single LT arm followed by RT leg
2) 2nd, simultaneous RT arm/LT leg (A)
3) 3rd, Draw a square with the extended limbs (B) (limb ROM only – no torso movement); note the arm/leg 1st abduct, then downward, then adduct, then upwards (alter speed/hold times)

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Note the different EMG muscle activation patterns by varying the exercise!

**TAKE HOME**: Use the exercise forms as a STARTING POINT to build from. Add dynamic movement to each exercise. Change it EACH VISIT – **MAKE IT FUN!!!**
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Summary of Publications

Books = 3
Chapters in books = 25
Full refereed journal papers = >170
Refereed conference papers = >140
Keynote addresses = > 50
Other invited addresses = 330 plus
Self initiated addresses = 150 plus

Books

   Now also printed in Chinese, 2009.

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