

# Conservative Management of Low Back Pain in Physical Therapy

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## Clinical Practice Guidelines

- Orthopedic Section of APTA
- WHO ICF (International Classification of Functioning, Disability and Health).
- Purpose of guidelines:
  - Describe EBP for PT, including diagnosis, prognosis, intervention and assessment of outcome, for musculoskeletal disorders commonly managed by orthopedic physical therapists
  - Classify and define common musculoskeletal conditions using the WHO's terminology related to impairments of body function and body structure, activity limitations and participation restrictions.
  - Identify appropriate outcome measures to assess changes resulting from physical therapy interventions in body function and structure, activity and participation
  - Provide a description to policy makers using internationally accepted terminology of practice of orthopedic physical therapists

Delitto, et al, 2012.



# Clinical Practice Guidelines



- Provide information for payers and claims reviewers regarding the practice of orthopedic physical therapy for common musculoskeletal conditions
- Create a reference publication for orthopedic physical therapy clinicians, academic instructors, clinical instructors, students, interns, residents and fellows regarding the current practice of orthopedic physical therapy
- Purpose: describe the peer-reviewed literature and make recommendations related to treatment matched to low back pain subgroup responder categories, treatments that have evidence of low back pain, and treatments that have evidence to influence the progression from acute to chronic low back pain and disability

Delitto, et al, 2012.

## Levels of evidence

I	Evidence obtained from high-quality diagnostic studies, prospective studies, or randomized controlled trials
II	Evidence obtained from lesser-quality diagnostic studies, prospective studies, or randomized controlled trials (eg, weaker diagnostic criteria and reference3 standards, improper randomization, no blinding, <80% follow-up)
III	Case-controlled studies or retrospective studies
IV	Case series
V	Expert opinion

Delitto, et al, 2012.

# Grades of evidence

GRADES OF RECOMMENDATION BASED ON		STRENGTH OF EVIDENCE
A	Strong evidence	A preponderance of level I and /or level II studies support the recommendation. This must include at least 1 level I study.
B	Moderate evidence	A single high-quality randomized controlled trial or a preponderance of level II studies support the recommendation
C	Weak evidence	A single level II study or a preponderance of level III or IV studies, including statements of consensus by content experts, support the recommendation
D	Conflicting evidence	Higher-quality studies conducted on this topic disagree with respect to their conclusions. The recommendation is based on these conflicting studies.
E	Theoretical/foundational evidence	A preponderance of evidence from animal or cadaver studies, from conceptual models/principles, or from basic science/bench research supports this conclusion
F	Expert opinion	Best practice based on the clinical experience of the guideline development team
		Delitto, et al, 2012.

babies

## Common Diagnoses for LBP



- Sciatica
- Strains
- Sprain
- Spasms
- Disk herniation
- Spinal stenosis
- Osteoporosis
- Osteophytes
- DDD
- DJD

Brill, 2001.

## Prevalence



- - 1 yr incidence of 1<sup>st</sup> ever LBP range b/t 6.3 and 15.3%
- - 1 yr incidence of LBP range b/t 1.5 and 36%
- LBP is leading cause of activity limitation and work absence and is associated with enormous economic burden
- Individual with activity limiting LBP often experiences reoccurrence with range of 24-36%

Delitto, et al, 2012.

- One in four US adults – day long bout of pain in past month, 1/10 have pain lasting one year; 3/5 over 65 have pain over one year
- 1/5 of adults over 65 experience pain in past month that lasted greater than 24 hours

CDC Control and Prevention

## Prevalence



- In 2005, 2.5-3% of all physician visits were for LBP
- Cost of 85 billion annually
- Indirect costs – lost productivity exceeding 7 billion annually
- Most patients with LBP access system through PCP

Childs JD, 2012

- 84% of patients with new onset low back pain will improve in 30 days with or without treatment
- 92% of patients with new onset of low back pain will improve in 90 days with or without treatment
- What do we do with the other 8%

## Demographics



- LBP occurs in all strata of society
  - Women have higher prevalence
  - Increased age is associated with higher prevalence and more severe forms of LBP increase with age until age 60-65
  - Lower educational status has increased prevalence, longer duration and worse outcome
  - Occupational differences
    - High physical demand jobs such as material workers 39%
    - Sedentary workers 18.3%
  - Working vs. Nonworking groups have similar LBP prevalence rates

Delitto, et al, 2012.

## Risk Factors - Genetics



- Current literature does not support a definitive cause for initial episodes of LBP **Level B**
- Risk factors are multifactorial, population specific and only weakly associated with the development of LBP **Grade F**
- Genetics – linked to specific disorders of spine – disc degeneration is associated with genetics, body build, early environmental influences **Level II**
- Degenerative changes on MRI/CAT not strongly related to LBP symptoms
- + association with operating heavy equipment
- Genetics is not linked to nonspecific LBP
- Inconclusive evidence for relationship b/t trunk mm strength or mobility of lumbar spine and risk of LBP

Delitto, et al, 2012.

## Risk Factors - Psychosocial



- Psychosocial plays larger prognostic role **Level II**
- Changes in behavioral variables and reduction of disability that facilitate and improvement in function may be more important than physical performance factors for successful treatment of chronic LBP
- Fear may play role when pain has become persistent
- Distress/depression play important role at early stages
- Physical distress, depression and fear avoidance are well defined entities and are best assessed with specific screening tools
- No high quality evidence to support pain-drawing use as a psychological assessment tool

Delitto, et al, 2012.

## Risk Factors – Recovery **Level II**



Factors associated with prevalence of low back pain do not affect recovery of patients who already have low back pain. These include:

- Previous of low back pain
- Job satisfaction
- Educational level
- Marital status
- Number of dependents
- Smoking
- Working more than 8 hour shifts
- Occupation
- Size of industry or company or industry

Clinical course in patients with comorbidities is just as favorable as those without comorbidities

- Evidence supports one's own expectations of recovery as a predictor of decision to return to work
- Patients with higher expectation had less sickness absence
- Consistent evidence found for predictive value of pain intensity, several work related parameters and coping style

Delitto, et al, 2012.

## Summary of Risk factors – Moderate Evidence



- No definitive cause for initial episodes of LBP
- Risk factors are multifactorial, population, specific and only weakly associated with development of LBP

**Level B**

Delitto, et al, 2012.

- S&S of Low back dysfunction
  - Pain when reaching
  - Pain during or after sports
  - Quick sharp pain
  - Trouble standing upright after bending or sitting
  - Weak legs
  - Difficulty walking
  - Trouble lifting
  - Limited range of motion
  - Radiating leg pain

Brill P, 2001.

## Pathoanatomical Features



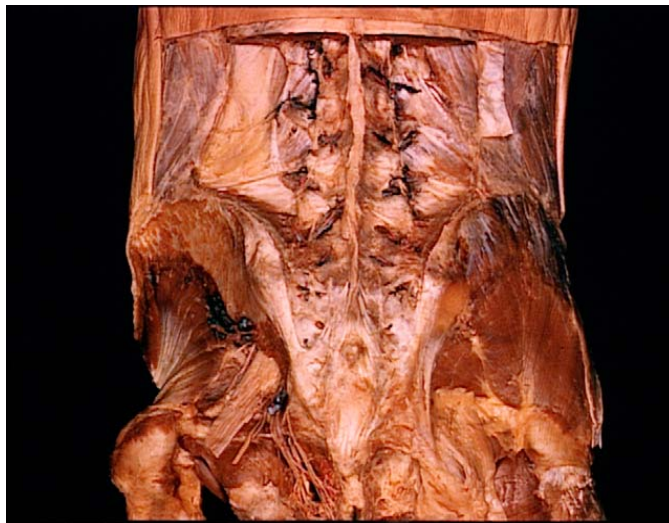
- Any innervated structure in the lumbar spine can cause symptoms of low back and referred pain in to the extremity (ies)
  - Muscles
  - Ligaments
  - Dura mater and nerve roots
  - Zygapophyseal joints
  - Annulus fibrosus
  - Thoracolumbar fascia
  - Vertebrae

Improvement in resolution of imaging technology has not increased likelihood of detecting a link between pathology and pain in the lumbar spine d/t false positive and on asymptomatic individuals

Delitto, et al, 2012.

## Lumbar Anatomy

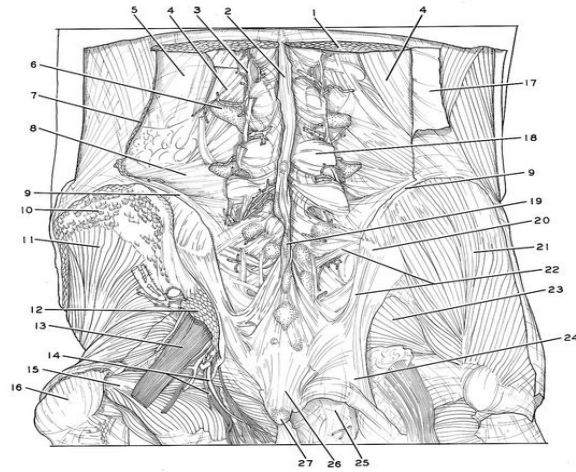
Pictures courtesy of Stanford Medical History Center





# Lumbar Anatomy

Pictures courtesy of Stanford Medical History Center



Ligaments of  
lumbosacral region,  
posterior view

**LIGAMENTS AND JOINTS OF LUMBOSACRAL  
SPINE AND PELVIC GIRDLE**  
Pictures courtesy of Stanford Medical History Center

1.	The erector spinae and gluteus maximus muscles have been removed. On the left the gluteus medius has been cut away.
2.	Supraspinous ligament
3.	Intertransverse ligament
4.	Quadratus lumborum muscle (covered by middle layer of thoracolumbar fascia)
5.	Left kidney (faintly visible through thoracolumbar and renal fascia)
6.	Transverse process vertebrae L. IV
7.	Latissimus dorsi muscle (cut edge)
8.	Iliolumbar ligament
9.	Iliac crest
10.	Area of origin of gluteus medius muscle
11.	Gluteus minimus muscle
12.	Piriform muscle (cut across)
13.	Sciatic nerve (emerging through greater sciatic foramen)
14.	Upper pointer: Internal pudendal artery Lower pointer: Pudendal nerve
15.	Obturator internus muscle (tendon of insertion)
16.	Greater trochanter
17.	Thoracolumbar fascia (posterior layer, reflected)
18.	Intervertebral joint capsule L. IV-V
19.	Middle sacral crest
20.	Posterior superior iliac spine
21.	Gluteus medius muscle
22.	Dorsal sacroiliac ligament
23.	Piriform muscle
24.	Sacrotuberous ligament
25.	Ischiorectal fossa
26.	Superficial dorsal sacrococcygeal ligament
27.	Coccyx

## Clinical Course



- Acute, subacute, recurrent or chronic
- Clinicians should place high priority on interventions that prevent:
  - Recurrences
  - Transition to chronic low back patients
- 65% of patients with acute low back pain reported 1 or more additional episodes in one year follow up
- 2 months median time to another episode of low back pain
- 60 days median total duration of LBP in the year
- Prognosis becomes less favorable and more variable **Level 2**

Delitto, et al, 2012.

## Clinical Course



- One year follow-up of patients with LBP followed by PCPs **Level II**
  - 69% with recent onset of LBP (past 6 months) reported having pain the last month
  - 21% were pain free at 1 year
  - 55% reported low disability and low pain intensity
  - 10% reported low disability and high pain intensity
  - 14% reported high disability with varying amounts of pain intensity
- Clinicians should consider screening for and addressing factors that increase the probability of developing chronic low back pain
- Clinicians should place high priority on interventions that prevent recurrences and the transition to chronic low back pain

**Grade E**

Delitto, et al, 2012.

## Diagnosis/Classification



- Most intervention studies have taken an approach where LBP is treated as homogenous entity
- Most clinicians perceive recognizable subgroups and researcher agree clinical care is improved with effective subgrouping methods
- Utility of subgrouping is limited based on pathoanatomy is limited by an inability to identify a pathological mechanism for most patients
- Emphasis in developing subgrouping methods for conservative is placed on patterns of signs and symptoms from clinical examination

**Level I**

Delitto, et al, 2012.

## Diagnosis/Classification

Acute or subacute	Mobility deficits
Acute , subacute, or chronic LBP	Movement coordination deficits
Acute LBP	Related lower extremity pain
Acute, subacute or chronic LBP	Radiating pain
Acute or subacute LBP	Related cognitive or affective tendencies
Chronic LBP	Related generalized pain

Delitto, et al, 2012.

## Diagnosis/Classification



- Evidence supports de-emphasizing pathoanatomical structures after red flag screening is completed
- LBP classification systems in literature based on clinical characteristics matched to management strategies likely to benefit them **Level II**
- Treatment based classification system
- Patients who receive interventions matched with their examination findings have better outcomes than patients who receive interventions not matched with examination findings **Level I**

Delitto, et al, 2012.

## Diagnosis/Classification



- Guidelines establish treatment guidelines to parallel ICF impairments
  - Low back pain with mobility deficits
  - Low back pain with movement coordination impairments
  - Low back pain with related lower extremity pain
  - Low back pain with radiating pain
  - Low back pain with generalized pain
- Low back pain with “related cognitive or affective tendencies” (appropriateness of emotion, content of thought)
- Generalized pain (impairments of sensory function)
- Patient’s level of acuity in terms of onset of symptoms and movement/pain relations **Level I**

Delitto, et al, 2012.

## Diagnosis/Classification



- 34% of patients have unclear treatment based diagnosis criteria
  - 529 people with LBP with unclear diagnosis
  - Less affected by LBP (lower levels of disability and fewer fear avoidance beliefs related to work and physical activity)
  - Longer duration of symptoms than participants who had clear classifications
  - Tend to be older, have had a previous episode of LBP

Stanton TR, et al, 2013.

## Differential Diagnosis



- **Goal of diagnosis is to match patient's clinical presentation with the most efficacious treatment approach and appropriateness for physical therapy management**
- **Small percentage have serious medical condition or psychosocial factors**
  - Cancer
  - Spinal infection
  - Cauda equina syndrome
  - Spinal stress fractures
  - Spinal compression fractures
  - Ankylosing spondylitis
  - Aneurysm

**Level III**

Delitto, et al, 2012.

## Differential Diagnosis



- **Yellow flags commonly used in the literature**
  - Psychological and social factors that may be contributing to persistent pain and disability or contribute to transition from acute to chronic disabling condition
- **Modification of rehabilitation program to emphasize:**
  - Active rehabilitation
  - Graded exercise programs
  - Positive reinforcement of functional accomplishments, and or
  - Graduated exposure to specific activities that patient fears as potentially painful or difficult to perform

**Level V**

Delitto, et al, 2012.

## Physical Therapy Evaluation



- Subjective Examination
- Objective Examination
- Movement Examination
- Repeated Movements
- Passive Movement
- Unweighting/Unloading
- Soft Tissue Examination
- Special Tests
- Function
- Education
- Outcomes

Schenk R, 1996

## Examination – Outcome Measures

- **Medical Outcomes Survey Short-Form 36 (SF-36)** – most often used generic health status index
- **Oswestry Disability Index (ODI)** – commonly used to capture perceived disability in patients with low back pain
- **Roland-Morris Disability Question** – region specific and easy to administer
- **Quebec Back Pain Disability Scale** – failed to gather widespread adoption
- **Visual analog scale**
- **Numeric pain scale**



**Level I**

**Level I**

Clinicians should use validated self report questionnaires for base line status relative to pain, function and disability for monitoring a change in status throughout course of treatment **Grade A**

Delitto, et al, 2012.

## Examination – Activity Limitation and Participation Restriction Measures

- Self reported instruments in determining a person's overall functional abilities as described in the ICF
- Especially in return to work activity limitations and participation restriction
- FCEs
  - Blankenship system
  - ERGOS work simulator
  - Ergo-Kit
  - Isernhagen work system - Good interrater reliability and predictive validity
- Clinicians should routine assess activity limitation and participation restriction through validated performance-based measures; monitor patient progress with same measures over course of treatment



**Level III, Grade F**

Delitto, et al, 2012.

## Wilson stretching

## Physical Impairment Measures



- Lumbar active ROM
- Segmental mobility assessment
- Pain provocation with segmental mobility testing
- Judgments of centralization during movement testing
- Prone instability test Rabin A, et al, 2013.
- Judgment of presence of aberrant movement
- Straight leg raise
- Slump test
- Trunk muscle power and endurance
- Passive hip internal rotation, external rotation, flexion and extension Rabin A, et al, 2013.
- Clinical prediction rule for predicting success with Lumbar Stabilization Exercises using 4 clinical tests had good interrater reliability and predictability Rabin A, et al, 2013.

Delitto, et al, 2012.



## Mental Impairment Measures



- Fear-Avoidance Beliefs Questionnaire (FABQ)
  - Self-report, continuous scale, acceptable reliability, good test-retest reliability
  
- Pain Catastrophizing Scale
  - Self-report, continuous scale, internally consistent
  
- Örebro Musculoskeletal Pain Screening Questionnaire
  - Self-report, continuous scale, can predict long term pain, disability, sick leave

Delitto, et al, 2012.

## Mental Impairment Measures



- STarT – Subgroups for Targeted Treatment Back Screening Tool
  - Self-report, acceptable test-retest validity
  - Bothersomeness items: 5 point Likert scale
  - Remaining items: dichotomous scale
  - Observational cohort study to test predictive value of STarT
    - Compared to FABQ-PA and FABQ-W, PCS, Tampa Scale of Kinesiophobia (TSJ-11), and Patient Health questionnaire (PHQ-9)
    - Strengths of study – compared SBT (STarT Back Test) to other psychological measures, focused on modifiable psychological risk factors
    - Weakness of study – aligned with fear avoidance models, physical therapy was not standardized, self report outcome measures

Beneciuk JM, et al, 2013.

## Interventions – Manual Therapy



- Thrust and nonthrust mobilization/manipulations **Level I**
  - The presence of 4 or more predictors increased probability of success with thrust manipulation **Level II**
    - Duration of symptoms less than 16 days\*
    - No symptoms distal to the knee\*
    - Lumbar hypomobility
    - At least 1 hip greater than 35°
    - FABQ-W score less than 19
- Clinicians should consider thrust manipulation procedures to reduce pain and disability in patients with mobility deficits and acute low back pain and back-related buttock or thigh pain.

**Grade A**

Delitto, et al, 2012.

## Interventions – Trunk Coordination, Strengthening and Endurance exercises



- Acute, subacute, and chronic low back pain
  - Exercise therapy decreases pain in chronic population
  - Graded exercise improved absenteeism in subacute population
  - Exercise program is as effective as other conservative treatments or no treatments in acute population **Level I**
- Clinical prediction rule for stabilization
  - Age less than 40, Positive prone instability test, Presence of aberrant movements with motion testing, SLR greater than 91° **Level II**

Delitto, et al, 2012.

## Interventions – Trunk Coordination, Strengthening and Endurance exercises



- Moderate-quality evidence that post discharge exercise programs can prevent recurrences of low back pain **Level I**
- RCT – Multifidus and transverse abdominis muscle training reported recurrence rates of 30% at one year compared to 84% at one year for advice and medication group **Level I**
- Clinicians should consider trunk coordination, strengthening, and endurance exercises to reduce low back pain and disability in patients with subacute and chronic LBP and movement coordination impairments in patients post-lumbar microdiscectomy **Grade A**

Delitto, et al, 2012.

## Interventions – Centralization and Direction Preference Exercises and Procedures



- Systematic review
  - McKenzie therapy is more effective than comparison treatments (nonsteroidal anti-inflammatory drugs, educational booklet, strengthening, etc) at short term follow-up
  - Centralization is a commonly encountered subgroup of low back pain and with good reliability during examination
  - Long-term follow-up favored advice to remain active over McKenzie exercise **Level I**
- Subject specific treatment is superior to others in creating good outcomes **Level I**
- Clinicians should consider utilizing repeated movements, exercises or procedures to promote centralization to reduce symptoms in patients with acute LBP and related (referred) lower extremity pain **Grade A**

Delitto, et al, 2012.

## Intervention – Flexion exercises



- **Williams flexion exercise**
  - Standard treatment for patients who are older with lumbar spinal stenosis
  - Performed in supine, seated, and standing positions
  - RCT
    - Compared manual therapy, exercise and body weight-supported treadmill walking group vs. Lumbar flexion exercise, treadmill walking, and walking program
    - Manual therapy group had better outcomes at 6 weeks and at one year **Level II**
  - Additional studies – long-axis distraction, nerve mobilization, quadruped joint mobilization, daily flexion exercises **Level III**
- Clinicians can consider flexion exercises combined with interventions such as manual therapy, strengthening exercise, nerve mobilization procedures and progressive walking for reducing pain and disability in older patients with chronic LBP and radiating pain **Grade C**

Delitto, et al, 2012.

## Interventions – Lower Quadrant Nerve Mobilization Procedures



- Neural Flossing RCT –
  - Subacute low back pain and leg symptoms who were unable to improve or worsen their symptoms with lumbar flexion and extension motions, had a positive slump test
    - Nonthrust mobilization of lumbar spine and exercise
    - Slump stretching and exercise x 6 sessions
  - Slump group exhibited significantly reduced disability **Level II**
- Cohort study
  - Patients with lumbar stenosis
  - Demonstrated increase in SLR **Level III**
- Clinicians should consider utilizing lower-quarter nerve mobilization procedures to reduce pain and disability in patients with subacute and chronic LBP and radiation pain **Grade C**

Delitto, et al, 2012.

## Interventions - Traction



- Systematic review of 25 RCTs and RCTs
  - Moderate evidence showing no statistically significant difference in short- or long-term outcomes between traction as single treatment and placebo, sham or no treatment
  - Intermittent or continuous mechanical traction as single treatment of low back pain cannot be recommended for heterogeneous groups of patients with LBP with or without sciatica **Level I**
- RCT to investigate whether there is a subgroup of patients with LBP who benefit from traction and exercise patients with peripheralization of symptoms with extension movement and positive crossed straight leg raise test **Level II**
- There is moderate evidence that clinicians should not utilize intermittent or static lumbar traction for reduction symptoms in patients with acute or subacute, nonradicular pain in patients with chronic low back pain. Subgroup of patients with nerve root compression with peripheralization of symptoms or positive crossed straight leg raise will benefit from traction. **Grade D**

Delitto, et al, 2012.

## Interventions – Patient Education and Counseling



- Traditional intervention for acute, subacute and chronic LBP
  - Research focused on 3 main approaches
    - General education and advice in acute and subacute populations
    - Behavior education
      - Cognitive behavioral theory
      - Graded activity and graded exercise in a variety of populations
      - Education of patients on the pathology of pain
    - Remain Active, avoid bed-rest, and acknowledge the history of LBP **Level I**
- Acute patients – stay active
- Subacute and chronic – exercise, functional activities to promote self management **Level I**
- Novel education booklet de-emphasized education on pathology an disease process, provided reassurance regarding likelihood of recovery and promoted positive attitudes with significantly greater early improvement in beliefs that were maintained at one year

Delitto, et al, 2012.





## Interventions – Progressive Endurance Exercise and Fitness Activities



- Chronic LBP – most national guidelines endorse progressive aerobic exercise with moderate to high level evidence
- Chronic low back pain and related generalized pain – neural sensitivity to afferent stimuli, including proprioception and movement
  - Termed central sensitization
  - Underlying psychosocial factors, deficits in aerobic fitness, tissue deconditioning
  - Aerobic fitness has been hypothesized to be important component of reducing pain and improving function **Level I**

Delitto, et al, 2012.

## Interventions – Progressive Endurance Exercise and Fitness Activities



- **Patients with generalized pain complaints should be managed at lower intensity levels of training**
  - Excessive levels of exercise may be responsible for increased symptom complaints due to increase in immune activation with release of proinflammatory cytokines, blunted increase in muscular vascularity leading to widespread muscular ischemia, inefficiencies in endogenous opioid and adrenergic pain-inhibitory mechanism **Level I**
- Clinicians should consider moderate to high intensity exercise for patients with chronic LBP without generalized pain and incorporating progress, low intensity submaximal fitness and endurance activities in the pain management and health promotion strategies for patients with chronic low back pain with generalized pain **Grade A**

Delitto, et al, 2012.



## How Can I Improve My Sleep?

### Articular Neurology and Sleep

Grant L, 2013.

#### Joint Mechanoreceptors

<b>Type 1</b>	Mechanoreceptors in joints and ligaments	Thickly encapsulated and respond with rapid adaptation in the joint; dynamic receptors at beginning and end range of motion
<b>Type 2</b>	detect tension in the joints resulting in slow or rapid adaptation response within the tissue or joint	
<b>Type 3</b>		
<b>Type 4</b>	Nociceptive pain response, becomes active when irritation from chemical or inflammatory process within the tissue in which it lies	Especially influenced during positions of sleep in which the posture of the spine can be set up to receive provocation from pain Provide a sensory afferent from the joint and synapse into an alpha motor neuron pool which effect muscle efferent response (motor)

## How Can I Improve My Sleep?



- Sleep and pain
  - Post op patients have a loss of deep REM sleep and decreased rapid eye movement
- Therapy treatment for pain reduction
  - Stress reduction
  - Body mechanics
  - Exercise
  - Nutrition
  - Obesity/pain management- patients with poor sleep have goal to improve metabolism and glucose tolerance through progressive exercise without exacerbating pain which leads to better pain control and improved psychological affect
- Mattress
  - Try for a minimum of 10 minutes
  - Appropriate firmness
  - Replace every 10 years

Grant L, 2013.

## Interventions - Complementary Therapies



- Pilates for chronic nonspecific LBP
  - RCT – 86 patients
  - Limitations – treatment provider and participants could not be blinded to interventions
  - Addition of modified Pilates exercises to educational booklet provides small to moderate short term benefits compared to education alone
  - Effects were not sustained over time Miyamoto GC, et al, 2013
- The Core Program Brill P, 2001.
- Yoga
- Tai Chi
- Myofascial Release

## Teach Difference between Good and Bad Pain



	GOOD PAIN	BAD PAIN
Sensation	Dull ache	Sharp pain
Location	In the muscle	In or near the joint
After exercise	Relieved within minutes	Continues to hurt
Next session	Same effort is less painful	No improvement or worse
What it means	Normal muscle fatigue	Problem with a joint or muscle

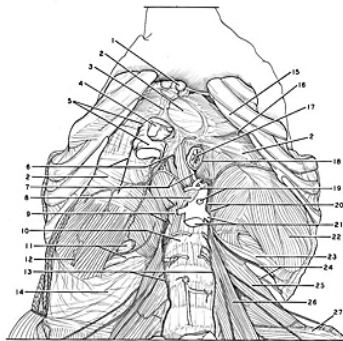
Nelson, M, 1997.

## Postural Function of Respiratory Diaphragm in Persons with Low Back Pain

Pictures courtesy of Stanford Medical History Center

- Study: Trunk stabilization and postural trunk control may play an important role in the etiology of low back pain
  - Case control study of 29 health subjects
  - 18 patients with chronic LBP due to chronic overloading
  - Smaller diaphragm excursion and higher diaphragm position found in group during UE tidal breath and LE TB conditions
  - Patients with chronic LBP appear to have both abnormal position and steeper slope of the diaphragm which may contribute to the etiology of the disorder

- Diagram of respiratory diaphragm



## Osteoporosis – Bone health



- Progressive bone loss and increased risk of fracture
  - Birth to 25 – good remodeling, add more bone than you lose, with maximum bone mass at around age 25
  - 25-35 – Maintain bone density, neither gaining nor losing
  - 35 – menopause – natural tendency is to lose bone, up to 1% per year
  - First 5 years after menopause – 1-2% loss every year
  - 55-75 – bone loss slows down
  - 70 and older – average rate of loss slows to .5 % per year

Greenberger P, 2006.

## Osteoporosis – Bone health



- “The only time in a woman’s life to build solid bone mass is during youth. Too often, though lack of exercise and fear of gaining weight from calcium-rich dairy products sabotage this priority. After age 30, prevention strategies switch to preserving the bone that is already there. Calcium and weight-bearing exercise are required for optimal bone health.”
- Food first
- Bone Health – synergistic for protein, vitamins D, K, C and A, magnesium, potassium, phosphorous, zinc
- Exercise helps build bone during the critical ten years; moderate physical activity is associated with higher bone mineral density in postmenopausal women

Greenberger P, 2006.

## Osteoporosis – Bone health



- Affects 52 million Americans, mostly women
  - Underdiagnosed and undertreated
- Signs of bone loss
  - Fall with broken bone
  - Bone density test with below normal scores
  - Diminished height
- Once bone density is lost, difficult or impossible to replace
- Fracture zone: bones become so fragile that they could break from falls or from ordinary activities

Ip EW, et al.

# FRAX

- Available at
  - [www.iofbonehealth.org](http://www.iofbonehealth.org)
  - [www.nof.org](http://www.nof.org)
  - [www.ipof.r.jp](http://www.ipof.r.jp)
  - [www.esceo.org](http://www.esceo.org)
- iPhone app
- Recent development from the WHO that incorporates weight of certain clinical risk factors with or without BMD information and computes 10 y probability of osteoporotic fracture and/or hip fraction

Ip EW, et al.

# FRAX

## Charts to download

Charts of the FRAX® tool are available to download for office use. The FRAX® charts give fracture probabilities according to the number of risk factors that are found in an individual. Charts are available for:

- men and women aged 50 years or more,
- the 10-year probability of hip fracture or of a major osteoporotic fracture (osteoporotic spine, hip, forearm and humerus fractures).

You can select charts that give fracture probabilities according to body mass index or according to the T-score for femoral neck. Note that when both BMI and BMD are available, better characterization of risk is provided with BMD. For the purposes of these tables secondary causes of osteoporosis should not be used other than a history of rheumatoid arthritis when using the tables with BMD. Any of the secondary causes of osteoporosis can be used with the BMI charts.

The example below gives the ten-year probability of a major osteoporotic fracture for women aged 65 years from the UK according to the number of clinical risk factors (CRFs) and the T-score for BMD.

Table. Ten-year probability of osteoporotic fractures (%) according to BMD T-score at the femoral neck in women aged 65 years from the UK.

Number of CRFs	BMD T-score (femoral neck)					
	-4.0	-3.0	-2.0	-1.0	0	1.0
0	27	15	9.7	7.1	5.9	5.0
1	37 (35-41)	22 (16-26)	14 (10-18)	10 (7.5-14)	8.5 (5.7-12)	7.3 (4.8-10)
2	49 (42-58)	30 (23-40)	20 (13-29)	15 (9.6-23)	12 (8.6-18)	10 (5.6-17)
3	62 (55-72)	41 (30-55)	27 (17-42)	20 (11-34)	17 (8.7-29)	15 (7.2-26)
4	73 (65-81)	52 (42-65)	36 (26-51)	27 (16-43)	23 (14-38)	20 (11-32)
5	83 (76-87)	64 (58-72)	47 (40-57)	38 (28-47)	31 (22-41)	27 (19-38)

Ip EW, et al.

# FRAX

6	69	75	58	45	40	35
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Thus a woman aged 65 years with a T-score of -2 SD with no clinical risk factors would have a fracture probability of 9.7%. With two clinical risk factors, the probability rises to 20%. Note that a range is given (13-20% in this example). This is not a confidence estimate. The range arises because the different risk factors have different weights. For example, smoking and excess alcohol consumption are relatively weak risk factors, whereas a previous fracture or a family history of hip fracture are strong risk factors. Thus patients with weak risk factors are likely to have a fracture probability closer to the lower end of the range (i.e. 13%).

Where BMD is not available, BMI can be used. An example is given below, again giving the probability of a major osteoporotic fracture for women aged 65 years from the UK according to the number of clinical risk factors.

Table. Ten-year probability of osteoporotic fractures (%) according to body mass index (BMI) in women aged 65 years from the UK.

Number of CRFs	BMI (kg/m <sup>2</sup> )						
	15	20	25	30	35	40	45
0	11	9.3	8.6	7.4	6.5	5.6	4.9
1	16 (12-21)	14 (10-18)	13 (9.2-16)	11 (7.9-14)	9.8 (6.9-12)	8.5 (5.9-11)	7.4 (5.1-9.5)
2	24 (18-34)	21 (13-31)	19 (11-29)	17 (9.8-26)	14 (8.4-23)	13 (7.3-20)	11 (6.3-18)
3	35 (24-49)	30 (19-45)	27 (16-43)	24 (14-38)	21 (12-34)	18 (10-30)	16 (8.7-27)
4	48 (35-62)	42 (30-57)	38 (26-54)	34 (22-49)	30 (19-44)	26 (16-39)	23 (14-35)
5	62 (51-71)	56 (45-66)	51 (41-62)	46 (36-56)	41 (32-51)	36 (28-46)	32 (24-41)
6	75	70	65	59	54	48	43

Ip EW, et al.

# Risk factors



- Unavoidable Risk Factors
  - Gender
  - Age
  - Race - lighter skin equal greater risk
    - 54% of postmenopausal white women in US have osteopenia, 30% have osteoporosis
    - African American women over 50 - 30% low bone density 10% osteoporosis
  - Family history – genetics, mother or grandmother
  - Body type: smaller frame and thinner women
  - Early menopause: before age 45 naturally or surgically
- Avoidable Risk Factors
  - Sedentary lifestyle
  - Menstrual interruptions – often associated with eating disorders, excessive exercise combined with inadequate diet such as athletes and dancers
  - Poor diet – Calcium and Vit D
  - Cigarette smoking
  - Drinking – more than 7 drinks per week interferes with calcium metabolism
  - SSRI medication for depression
  - Depo Provera
  - Vegan diet without vitamin or mineral supplementation
  - LBP
  - Long term steroid use
  - Drug and alcohol abuse
  - Mm weakness

Greenberger, 2006.

## Clinical Risk Factors



- PTs have knowledge base, tools and skills to identify these patients and prevent future fractures and disability with proper management of screened patients
- >90% of hip fractures occur as a result of a fall
- Fall Risk Factors - integral part of Osteoporosis screening
  - History of falling \*
  - Muscle weakness
  - Environmental hazards
  - Balance
  - Cognition
  - Visual impairments

Greenberger, 2006.

## Treatment



- SERMs – Specific estrogen receptor modulators
  - New anti-estrogen
  - Raloxefine
    - increases bone density in spine and hip
    - 30% reduction in incidence of vertebral fractures in women with existing vertebral fractures, 50% reduction in new vertebral fracture in women without pre-existing fracture
  - ERT – Decreases risk of hip fracture with increased risk of breast fracture and circulatory problems

Greenberger, 2006.

## Treatment



- Bisphosphonates – antiresorptive drugs
  - Slows rate of bone loss and increases bone density
- Alendronate, etidronate, risedronate
  - Increase BMD by 3-10% with decrease in vertebral fracture by 50% and hip fracture
  - Only therapies to decrease hip fracture risk
  - Weekly dose
- Ibandronate
  - Single monthly dose
  - Decreases spinal fractures by 50%, increases bone density @ all sites
  - No hip fracture data available yet
- Teriparatide
  - Builds new bone
  - Given as injection to patient with history of fractures or high risk for them
- Calcitonin
  - Nasal spray, not as effective as HT, SERMS, or bisphosphonates

Greenberger, 2006.

## Treatment



- Randomized single assessor of blinded randomized controlled pilot trial
  - Exercise – clinician led weekly
  - Daily home exercise program
  - Assessed at base line and 11 weeks – questionnaires re: back pain, physical function and health related QOL
  - Objective measures – thoracic kyphosis, back and shoulder endurance and function (TUG)
- Results
  - Significant reduction in pain during movement, improvements in physical function, timed loaded standing test
- Conclusion: Benefits of exercise and manual therapy in clinical management of patients with osteoporotic vertebral fractures

Bennell KL, et al, 2010



## Fragility fractures



- Bone fracture is often first sign of osteoporosis
- Fragility fracture occurs as a result of relatively minor injury or blow, such as falling from standing height or less
  - Vertebra, hip, wrist and shoulder
  - Hip is most costly and debilitating
  - More than half of women age 50 experience fracture at some point in their lives
  - Over 75 yo, most common surgery is repair of hip fracture with 1 of 4 requiring extended rehab
- Female Athlete Triad
  - Abnormal eating habits, menstrual dysfunction and osteoporosis

Greenberger, 2006

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