



**INNOVATIVE INTERVENTIONS FOR POSTURAL CHANGE IN OSTEOPOROSIS
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(12 page hand-out)**

Course Description

- Integration of **physical agents and manual therapy with traditional exercise** in the management of patients with **osteoporosis**.
- Focus - effective **treatment of kyphosis, forward head posture, and impaired scapular mechanics** in patients with a physical therapy diagnosis of **Impaired Posture**.
- Use of **valid and reliable outcome measures** will be discussed as it applies to clinical practice and research.

Objectives

- **Integrate** appropriate **outcome measures** into clinical practice to examine **efficacy** of interventions for osteoporosis patients with **kyphosis, forward head posture, and impaired scapular mechanics**.
- Utilize a **problem-solving hierarchy** to prioritize treatment to the **area of greatest restriction**.
- Integrate **manual therapy techniques with therapeutic exercise to facilitate postural change** (osteopathic Muscle Energy Technique, Mulligan Mobilization with Movement, Soft Tissue Mobilization).
- Select and administer **electrical stimulation and other physical agents** to assist in affecting postural change.
- Design **exercise interventions** to increase both core and extremity strength and mobility.

Course Outline

- ❖ **Introduction**
- ❖ **Problem statement**
 - ❖ **“Picture” of the kyphotic osteoporotic patient**
- ❖ **Problem-solving hierarchy**
 - ❖ **Tests & Outcome measures**
 - ❖ **Plan of care**
- ❖ **Interventions**
 - ❖ **Postural education**
 - ❖ **Manual therapy**
 - ❖ **Muscle Energy Technique**
 - ❖ **Mobilization with Movement**
 - ❖ **Soft tissue mobilization**
 - ❖ **Exercise**
 - ❖ **Physical Agents**

Definition of Osteoporosis (National Osteoporosis Foundation, 2002)

❖ **Metabolic bone disease**

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- ❖ **Characterized by**
 - ❖ **Low bone mass**
 - ❖ **Microarchitectural deterioration of bone tissue**

Epidemiology and incidence (National Osteoporosis Foundation, 2002)

- **44 million people** in the US have either osteoporosis or low bone mass (2002) - **55 percent of those aged 50 or older.**
- **>10 million people already have osteoporosis.** This will rise to almost 12 million by 2010, and to ~14 million by 2020
- **~8 million women and over 2 million men in 2002.**
- Non-hispanic white women disproportionately affected
- The number of men of all races and ethnic groups who are affected is significant.

The Size of the Problem (U.S.) (Riggs BL, Melton LJ 1995)

- ❖ As many as **40% of women over age of 50 years will experience an osteoporotic fracture** in their remaining lifetime
- ❖ **Lifetime risk of an osteoporotic fracture for white men over age 50 is 13%**
- ❖ **1.5 million osteoporotic fractures annually**
 - ❖ **>750,000 spine fractures (7:1 female to male)**
 - ❖ **>300,000 hip fractures (3:1 female to male)**
 - ❖ **>240,000 wrist fractures (1.5:1 female to male)**
- ❖ **1/3 of all women will develop osteoporosis**

Osteoporotic Vertebral Fractures and Mortality Data (Kado DM, et al., 1999)

- ❖ 1915 women (20.0%) from a total of 9575 women aged 65 years or older with 1 or more fractures had a **1.23-fold greater age-adjusted mortality rate** over 8.3 years.
- ❖ **Mortality rises with greater numbers of vertebral fractures**, from 19 per 1000 woman-years in women with no fractures to 44 per 1000 woman-years in those with 5 or more fractures (p for trend, <.001).
- ❖ Vertebral fractures were **related to the risk of subsequent cancer** (hazard ratio, 1.4) and **pulmonary death** (hazard ratio, 2.1)

Kyphosis with forward head:

Common associated mechanical problems

- ❖ **Shortened anterior trunk musculature**
- ❖ **Backward lean**
- ❖ **Extended A-O and C spine**
- ❖ **Flexed C7 through T 8-10**
- ❖ **Decreased lordosis**
- ❖ **TMD with weakened tongue**
- ❖ **Hyperextended knees**
- ❖ **Ankle eversion, pronated feet**

Impairments (APTA Guide to Physical Therapist Practice, 2001)

- ❖ **Forward head/kyphotic posture**
- ❖ **Impaired joint mobility associated with inactivity**
- ❖ **Prolonged muscle weakness or paralysis**
- ❖ **Muscle imbalance**

Problem Statement

- ❖ Impaired posture in patients with osteoporosis results in **functional limitations** in:
 - ❖ **Functional reach**
 - ❖ **Maintaining erect posture**
 - ❖ **Dressing/** choosing clothes

- ❖ Dangers in **lifting** and carrying
- ❖ Any functional ADL requiring **forward bend** moment
- ❖ Alters COM

T 7 Compression Fracture -

X-ray Before and After

Relationship between kyphosis, bone density & mechanical fracture risk

- ❖ Decreased lordosis, increased kyphosis, and protracted shoulder girdle with forward head have been observed to be clinically associated with osteoporotic vertebral fractures as well as with mechanical diagnoses such as paraspinal muscle strain and disc disease (Ryan, 1997).
- ❖ Women with prevalent spinal fractures have an increased risk of developing additional spinal fractures (Davis, 1999)

Fracture force risks during bending and lifting (Schultz AB et al., 1982)

- ❖ Compression loads imposed on the L3 motion segment by 30° of trunk flexion
 - ❖ 1800 N with arms at chest
 - ❖ 2610 N with arms anterior, holding 2 kg in each hand

Vertebral Load as a Result of Posture/ Movement (A-F from lowest to highest load)

Biomechanical Conclusions – Extrasketal Fx Determinants (Hamill J, Knutzen K, 1995)

- Inferences from ergonomic work along with clinical histories would imply that **gross trunk flexion**, especially when combined with lifting would put the osteoporotic **spine at risk** for these crippling and ultimately life-shortening vertebral compression fractures.
- **Golf-related compression** fractures probably reflect an increased **flexion** moment during the **midswing** phase.
- (Ekin JA and Sinaki M, 1993)

Practice Patterns (APTA Guide to Physical Therapist Practice, 2001)

- ❖ 4A: Primary Prevention/Risk Reduction for Skeletal Demineralization

❖ Must Specify the Type of Osteoporosis!

- ❖ 733.01 - Postmenopausal
- ❖ 733.01 - Senile
- ❖ 733.09 - Drug-induced
- ❖ 733.03 - Disuse
- ❖ 733.02 - Idiopathic
- ❖ 733.7 - Post-Traumatic

❖ 4B: Impaired Posture

- ❖ 737.1 – Curvature of spine (unspecified)
- ❖ 737.2 – Kyphosis
- ❖ 737.3 – Lordosis
- ❖ 737.4 – Kyphosis & scoliosis

4C: Impaired Muscle Performance

- ❖ 728.2 – Muscle wasting & disuse atrophy
- ❖ 729.1 – Myalgia, myositis, (unspecified)
- ❖ 729.4 – Fascitis
- ❖ 729.8 – Other musculoskeletal symptoms referable to limbs
- ❖ 781 – Symptoms involving nervous & musculoskeletal systems
 - ❖ 781.2 – Abnormality of gait

❖ 4F: Spinal Disorders

- ❖ 724.1 – Thoracic
- ❖ 724.2 – Lumbago
- ❖ 724.3 – Sacral dysfunction

❖ 4G: Fracture

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- ❖ **733.13 - Vertebral compression not due to trauma**
- ❖ **805.2 - Thoracic**
- ❖ **805.8 - Lumbar**

Tests and Measures:

A Biomechanical Picture

- ❖ Quality of **movement**
- ❖ Reason for faulty **alignment**
- ❖ Mechanical **safety** level (bones/balance)
 - ❖ Posture
 - ❖ Stability

Stadiometer

Kypholordosis Measurement

- ❖ Flexicurve Tracing
 - ❖ Multiple studies validate accuracy and reliability
 - ❖ Inexpensive (\$9.50 plus fine grid graph paper)
 - ❖ Time efficient (about 10 minutes when experienced)
 - ❖ Patient feedback gives motivation for change
 - ❖ **(Milne JS, Lauder IJ 1974, 1976) (Milne JS, Williams 1983) (Bethune DD et.al. 1986) (Lindsey et.al. 1995)**

Flexicurve Reproducibility (Lundon KM, Li AM, and Bibershtein S, 1998)

- Measurements in two subgroups of osteoporotic women, healthy backs (n = 11) and rounded backs (n = 13)
- Two-way analysis of variance (Intraclass Correlation Coefficient 2, 1) of collapsed data showed no significant difference in the reliability of the kyphometer, flexicurve ruler, or Xray in the measurement of thoracic kyphosis.

Forward Head Measurement

- **Tragus to wall (Viitanen JV, Kokko ML, Heikkila S, Kautiainen, 1998)**
 - Most easily attainable in clinic
 - Average L & R
- CROM
- Sagittal Assessment Gauge
- Grid Photo

Total Scapular Distance (DiVeta et al, 1990) (Gibson et al, 1995) (Roddey TS et al, 2002)

- ❖ Sum of the distance from T3 to the lateral aspect of left acromion and T3 to the lateral aspect of right acromion
- ❖ Stable measure of resting scapular position which is both reliable and cost effective

Trunk Range

- ❖ **Ribs/ilic crest distance**
- ❖ **Lateral basal expansion with respiration**

Two Joint Muscle Length Tests:

Pectoralis/ Latissimus Dorsi

- ❖ MUST contract abdominals to stabilize the thoracic cage and record a true measure
- ❖ Palpate to assess whether Pectoral or LD Area of Greatest Resistance

Strength and Functional Endurance

- ❖ **Timed loaded standing (Shipp et al, 2000)**
 - ❖ Normal – 3 minutes with 2 pounds in each hand
 - ❖ Shoulders at 90° flexion

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❖ Grip strength

- ❖ Associated with fall risk and lower BMD (**Aoyagi et al 2001**)

Abdominal Strength Grading

- ❖ Built with active contraction at BOTH RIB & PELVIC attachments

Trunk Extension Testing

- ❖ Essential Points:

- ❖ Symmetry
- ❖ Reversal of thoracic kyphosis
- ❖ No “hinging” at L4-5 or L5-S1
- ❖ 3 Repetitions held for 3 full seconds each

Yes, Seniors can do it!!!

Interventions

- ❖ Postural education and exercise

- ❖ Manual therapy

- Muscle Energy Treatment
- Soft tissue mobilization
- Mobilization with movement

- ❖ Physical agents

Prevent Fractures via Safe ADL Practices

Office/Computer Positioning: Uncorrected

- ❖ **What’s wrong with this picture?**

- ❖ Spine & head posture
- ❖ Chair height, angles
- ❖ Arm support
- ❖ Line of vision/ screen/ reference work
- ❖ Wrist angle
- ❖ Foot support

Office/Computer Positioning: Corrected

- ❖ **What’s right with this picture?**

- ❖ **Spine & head posture**
- ❖ **Chair height, angles**
- ❖ **Arm support**
- ❖ **Line of vision/ screen/ reference work**
- ❖ **Wrist angle**
- ❖ **Foot support**

Posture relief while working seated - (shoulders stay aligned over ischial tuberosities during each exercise)

- ❖ Alternating “C”

- ❖ **W**

- ❖ **T (money)**

- ❖ **V**

Bed Positions –TV/ Read

- ❖ Poor – flexed with no cervical or lumbar support

- ❖ Safe – LE’s supported in neutral (muscle length) as well as spinal curves

Safe Postures for ALL ADL

- ❖ What you got away with yesterday...

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- ❖ May result in a fracture tomorrow...

Mechanical variables to consider when designing trunk exercise

- ❖ **Torque** on vertebral bodies and discs

- ❖ **Efficiency** of actual strengthening

- Sufficient joint mobility
- Appropriate resistance

- ❖ **Common biomechanical “error”** tendency for each method

Disagreement in the exercise community over effectiveness and safety of different approaches to trunk exercise

- ❖ Divergent approaches

- **Sit-ups (“crunches”)** - lifting the head
- **Lower extremity progression** – lifting the legs

- ❖ **Public ignorance** regarding healthy vs. damaging exercise choices

- Planning a toning exercise program
- Recovery following spinal injury

Example of attempts to use abdominals as prime mover

- ❖ Poorly conceived exercise

- ❖ ADL done without risk awareness

- ❖ Vertebrae & disks are put in unnecessary risk position

Interaction of Mechanical and Physiologic Factors

- ❖ Length-tension relations of muscle

- 75% - 105% of muscle length – maximum muscle strength capability
- Passive insufficiency with abnormal muscle elongation
- Active insufficiency with abnormal muscle shortness

- ❖ Speed and power of contraction affect exercise outcome

(Moffroid and Whipple 1970, Kerr 1997)

Activity of trunk muscles essential prior to limb motion

- ❖ Cocontraction of transversus abdominis (TA) and multifidus (MF) always precedes limb movements

- ❖ Logical conclusion:

- CNS stabilizes the spine in anticipation of reactive forces produced by limb movements (Hodges and Richardson, 1997)

Safe Advanced Abdominal Exercises

- ❖ Built with active contraction at BOTH RIB & PELVIC attachments

Treatment record check works as part of eval

- ❖ What works and what doesn't indicates

- ❖ Functional strength
- ❖ Ease of motion
- ❖ Capabilities
- ❖ Limitations
- ❖ Appropriate exercise to address the problem

Evaluation and Exercise go hand in hand

- ❖ Assist patient to feel what's working and what is not

- ❖ Ideal alignment with every exercise and every ADL

- ❖ Progress only when preparatory exercise is mastered

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❖ **Exercise in ideal position, then progress to other positions of function**

Resistance principles for Bone Building & Posture Correction

- ❖ 80% RM for the individual patient
- ❖ 2-3 sets of 6-8 reps
- ❖ 2-3 X/ week
- ❖ Ideal posture
- ❖ Ear/ shoulder/ iliac crest

Exercise Precision

- Always correct relative flexibility faults

Resistance Machines – Targeting Spine

Senior Athlete with right shoulder pain & faulty gym program

- ❖ Sitting push-ups – promotes protraction
- ❖ Prone Push-ups in kyphotic posture

Weight exercises promoting kyphosis and protracted humeral head

Movement Faults Corrected

- ❖ Chair push-ups with ear over shoulder
- ❖ Wall push-ups replace faulty prone push-ups

Corrected resistance exercises

- ❖ Prone extension 4+/5
- ❖ Mid-trap strengthening with T-band

Cat stretch exercises in poor positions

- ❖ Promotes kyphosis & maintains shortened LD and pectorals
- ❖ Accommodates & maintains repeated limited shoulder ROM

Corrected program possible after soft tissue treatment and preparatory exercises

- ❖ Lengthened cat stretch promotes erect spine, full ROM of LD & pectorals
- ❖ Prone extension grade 5-/5 biomechanically correct w/o weights

Resistance Machines – Targeting Upper Extremity

❖ **Chest Press**

- ❖ Note head against seat back
- ❖ **Latissimus Pull Down** with bar in front
- ❖ Note “Chin in” posture

Select approach appropriate for the individual

Theraband Spinal/Shoulder Strengthening

- Care to avoid faulty trunk posture during extremity effort

Prone Head Lifts

- Paraspinal strengthening decreases kyphosis (Itoi E, Sinaki M, 1994)

Self P/A Mobilization

- ❖ **Dynamic co-contraction** stabilization of trunk muscles during limb activation
- ❖ Ball placed at kyphosis apex

Exercise Choices – Area of Greatest Resistance Addressed

- ❖ **Palpate for AGR**
- ❖ **Unsuccessful quadruped kyphosis reversal**
- ❖ **Successful cat stretch reversal**

Kyphoscoliosis

- Lengthening stretch for pectorals and latissimus
- Together with paraspinal contraction decreases both abnormal curves

Exercise program for Spinal stenosis, weak extensors, scoliosis

Severe osteoporosis & kyphosis s/p multiple compression fractures

Mechanical Treatment Planning Flow Path

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- ❖ Problem Area
- ❖ Findings – specifics if problems identified
- ❖ Problem-specific goals (Short term/ Long term)
- ❖ Solutions (Specific approach/ treatment)

Muscle Energy Techniques

- ❖ **Releases restricted joint motion** when the dysfunction is **caused by an abnormally facilitated muscle**
- ❖ Balances alignment and tone in all planes (a/p, med/lat, left/right)
- ❖ Can address limb, pelvic, and rib dysfunctions as well as spinal malalignments

Sequencing Evaluation

- ❖ **Identifies the area of greatest restriction (AGR)**
- ❖ **Allows practitioner to “follow the bouncing football” for treatment order-**
 - ❖ **From Ed Stiles, DO**

Spring Test for AGR Assessment

- ❖ Check for qualities of
 - ❖ Stiffness, resistance to spring
 - ❖ “Emptiness”
 - ❖ Edema, fibrosis, spasm
- ❖ Can be done standing or sitting
- ❖ Can be done in any position to check for left/right & A/P symmetry

Spring Palpation with GENTLE Compression Loading

- ❖ Three plane loading –
 - ❖ Cephalad/Caudal (downward approximation)
 - ❖ Rotation
 - ❖ Sidebending
- ❖ Approximate through
 - ❖ Head
 - ❖ Shoulders
- ❖ Check bilaterally
- ❖ Palpate ribs after testing spine

Example: Muscle Energy Correction for kyphosis with scoliosis - F SB (L) Rot (R)

Position at end corrected ROM for E SB (R) Rot (L)

- ❖ **Guide head into final C-T extension – “chin in”**
- ❖ **GENTLY compress through head 7 sec x3, stacking barriers before each repetition**
- ❖ **Practice sitting in corrected erect posture.**
- ❖ **Give exercises to - thoracic extensor strength in various positions.**

Importance of Soft Tissue Treatment

- ❖ **Tissue mobility is necessary for therapeutic movement**
 - Exercise
 - ADL
- ❖ Untreated soft tissue dysfunction can lead to unnecessary persistent movement dysfunctions
- ❖ **Vital when exercise can not correct the dysfunction**

Myofascial Release

- ❖ Gentlest of direct tissue approaches

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- ❖ Passive stretch applied
 - Light compressive contact
 - Tissue held in corrective direction for 30 seconds to 3 minutes
 - Release is SLOW

❖ Never painful

❖ Contraindications – infection, open wound, cancer

Protracted Humerus - Changes with MFR Treatment

❖ Before MFR

❖ After MFR

Contract/Relax with MFR

- Combines gentle PNF with soft tissue release

A/P cervical-thoracic releases

- Occiput/T1-4
- Occiput/Sternal

A/P Humerus/Thorax Releases

- Humeral/Sternal
- Humeral/Scapular

Adapted Positions for STM

❖ Adapted position for protracted humerus

❖ Adapt treatment when **frail patients are unable** to assume usual treatment postures (e.g. supine)

Mobilization with Movement (Mulligan BR, 1999)

- Stabilize scapula
- Passive posterolateral glide at the glenohumeral joint
- Active, then PROM into abduction

Thoracic Extension with Towel Roll and Overpressure

❖ Place towel at apex of kyphosis

Hands Behind Head Pectoral Release

- ❖ Active
- ❖ Hold-relax
- ❖ Combine with soft tissue mobilization

Thoracic Extension with Towel Roll and Overpressure

- Progressive alternating stretch with contract-relax

Hands Behind Head - Deep Tissue Mobilization for Tight Anterior Chest

- Active exercise
- Deep tissue mobilization

External Trunk Supports in the Work Place

- Posture corrector
- Posture training support
- Lumbar air cushion

Mechanical Treatment Planning Flow Path

❖ Problem solving process for each patient case

Case Study: Kyphosis - Compression Fractures when thrown off horse, subsequent car accident hanging upside down in belt. Example – results with treatment & feedback

- 12-00 – “usual best” and “cued ideal”
- Neck pain with attempt to maintain ideal posture
- 4-02 and 5-02 – “usual best” during course of PT w/ “X” taping, MET, postural exercise, &

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ADL applications

Kyphosis – corrective exercise

- **Prone trunk lift for trunk extensor strength**

Usual ‘best’ work position

- **Clavicle strap** and pillow support for kyphosis minimization
- Draft desk adaptation with pillow to **angle working surface**
- What’s wrong with this picture?

Desk work postural solutions

- Hip hinge (buttocks all the way back in chair)
- Pillow support
- Hip hinge w/o pillow

Kyphosis – athletic tape for postural facilitation

- **“X” taping stimulates** action of:
- Erector spinae, scapular adductors, mid and low trapezius
- **Retracts shoulders**
- Offers prolonged **stretch** for shortened **anterior thorax** tissue

Electrical Stimulation

- Paraspinal and lower trapezius strengthening (McQuain et.al. 1993)
- Spasm and pain relief (may combine with US)

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