WORKSHOP

Modern Rehabilitation in Osteoporosis, Falls & Fractures

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Athens, Greece

Disclosure statement

There are no relevant conflicts of interest to disclose
SUMMARY

• INTRODUCTION
• EXERCISE
• CALCIUM
• FALLS
• REHABILITATION AFTER FRACTURES
• DISABLED POPULATIONS

Modern Rehabilitation in Osteoporosis, Falls, and Fractures
Yannis Dionysiou, Grigoris Skaranolou and Panayiotis Papageorgopoulos
1st Department of Orthopaedics, General University Hospital Atikon, Chaidari, Greece.

ABSTRACT: In prevention and management of osteoporosis, modern rehabilitation should focus on how to increase muscular and bone strength. Resistance exercises are beneficial for muscle and bone strength, and weight-bearing exercises help maintain fitness and bone mass. In subjects at high risk for osteoporotic fractures, particular attention should be paid to improving balance—the most important element in falls prevention. Given the close interaction between osteoporotic and falls, prevention of fractures should be based on factors related to bone strength and risk factors for falls. Fractures are the most serious complication of osteoporosis and may be prevented. The use of modern methods such as vibration therapy to reduce pain and improve posture. Vibration platforms are used in rehabilitation of osteoporosis, based on the theory that mechanical vibration stimulation could have an impact on osteoporosis risk. Pharmacologic therapy should be added for those at high risk of fracture, and vitamin D supplementation is essential in all prevention strategies. Success of rehabilitation in osteoporotic and fractured subjects through an individualized educational approach optimizes function to the highest level of independence while improving the overall quality of life.

KEYWORDS: osteoporosis, rehabilitation, exercise, fractures, falls, calcium, vitamin D, vibration platforms
PART I
INTRODUCTION

REHABILITATION IS ALWAYS PRESENT
But why?

- Prevention of osteoporosis
- Assessment of risk factors (i.e. osteoporosis, falls, fractures)
- Management of osteoporosis
  - pharmacological – drugs and calcium, vitamin D, vitamin D analogues
  - non pharmacological
- Prevention of falls
- Rehabilitation of fractures

Answer to the question: because osteoporosis is a disease leading to disabilities
Rehabilitation Medicine optimizes functioning & promotes participation
Osteoporosis is defined as a skeletal disorder characterized by reduced bone mineral density and strength.

NIH Consensus Development Panel on Osteoporosis. JAMA 285 (2001): 785-95

• In modern rehabilitation medicine prevention and treatment of osteoporosis should not focus only on bone ignoring muscular strength and balance.

• These elements are directly related to the disease offering protection against predisposing a person to an increased risk of falls and fall-related fractures.
NORA: Fracture Rates, Population T-Score Distribution, and Number of Fractures

WHO fracture risk assessment tool
FRAX®

10-year probability of fracture

Country
Bone mineral density
Age
Gender

Clinical risk factors
- Low body mass index
- Previous fragility fracture
- Parental history of hip fracture
- Glucocorticoid treatment
- Current smoking
- Alcohol intake (3 or more units per day)
- Rheumatoid arthritis
- Other secondary causes of osteoporosis

www.shef.ac.uk/FRAX
The FRAX® tool gives immediate calculation of the 10-year probability of a major fracture (clinical spine, wrist, proximal humerus and hip) or hip fracture alone with or without the addition of BMD measured at the femoral neck.

Limitations of FRAX®

- Does not accommodate all known risk factors:
  - Falls, biochemical markers, QUS, etc.
- Lacks detail on some risk factors:
  - Dose response effects of glucocorticoids, smoking, prior fracture, etc.
- Depends on adequacy of epidemiological information
- Limited country models available
- Model relevant only for untreated patients
- Does not replace clinical judgment
Shifting the focus in fracture prevention from osteoporosis to falls

Preventing fractures in older people is important. But Teppo Järvinen and colleagues believe that we should be putting our efforts into stopping falls not treating low bone mineral density.


• the strongest single risk factor for fracture is falling and not osteoporosis !!


• A 1 SD reduction in bone mineral density increases the fracture risk 2-2.5 times.
• By contrast, a sideways fall increases the risk of hip fracture three to five times, and when such a fall causes an impact to the greater trochanter of the proximal femur, hip fracture risk is raised about 30 times.

After this short introduction I would like to introduce you Harold Frost (1921 – 2004), an US-American Orthopedic Surgeon

Mechanostat Hypothesis (1987-2003), was a product of the Gordon Conference (1957), the Sun Valley Workshops and interaction with colleagues. The originators were W.D. Armstrong, F.C. McLean, A. Reifenstein and I. Snapper, all long deceased, so the idea died and was buried. By 1987 Frost “dug up the “mechanostat” coffin, exhumed and published its contents and admitted he undeservedly received most of the credit for it”


FROST’s Mechanostat Theory

If sufficient load is applied to bone, a certain threshold strain in the bone is reached and bone is synthesized; if muscle load is below a certain set point, if for instance muscles are immobilized or paralyzed, bone tissue is lost.

bone strength is regulated by maximal muscle forces

PART II

EXERCISE FOR PREVENTION AND MANAGEMENT OF OSTEOPOROSIS AND PREVENTION OF FRACTURES
Physical Activity in the Prevention and Amelioration of Osteoporosis in Women
Interaction of Mechanical, Hormonal and Dietary Factors

Katarina T. Borre
Division of Kinesiology, The University of Michigan, Ann Arbor, Michigan, USA

Table I. The effects of exercise training during childhood and adolescence on bone density

<table>
<thead>
<tr>
<th>Study</th>
<th>Age (y)</th>
<th>No. of subjects</th>
<th>Age of onset of training (y)</th>
<th>Duration of training (y)</th>
<th>Volume of training (PVU)</th>
<th>Intensity</th>
<th>Activity</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morley et al.</td>
<td>5-10</td>
<td>50, 50</td>
<td>7-9</td>
<td>8</td>
<td>1</td>
<td>HI</td>
<td>Jumping</td>
<td>TBAD FT</td>
</tr>
<tr>
<td>Petchet et al.</td>
<td>8.1</td>
<td>80, 80</td>
<td>7.5</td>
<td>7</td>
<td>2</td>
<td>HI</td>
<td>Jumping</td>
<td>TBAD FT</td>
</tr>
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<td>Petchet et al.</td>
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<td>7</td>
<td>2</td>
<td>HI</td>
<td>Jumping</td>
<td>TBAD FT</td>
</tr>
<tr>
<td>Hassapiotis et al.</td>
<td>9.5-10.5</td>
<td>20, 20</td>
<td>6-8</td>
<td>2.5-6</td>
<td>2</td>
<td>HI</td>
<td>Tennis</td>
<td>TBAD FT</td>
</tr>
<tr>
<td>Morris et al.</td>
<td>10.4</td>
<td>100, 100</td>
<td>9.5</td>
<td>10</td>
<td>1.5</td>
<td>HI</td>
<td>Athletics</td>
<td>TBAD FT</td>
</tr>
<tr>
<td>McKeelke et al.</td>
<td>10.0</td>
<td>50, 50</td>
<td>10</td>
<td>7</td>
<td>1</td>
<td>HI</td>
<td>Jumping</td>
<td>TBAD LT, FN</td>
</tr>
<tr>
<td>Pettit et al.</td>
<td>10.7</td>
<td>40, 40</td>
<td>10</td>
<td>7</td>
<td>0.5</td>
<td>HI</td>
<td>Jumping</td>
<td>TBAD FT</td>
</tr>
<tr>
<td>Liang et al.</td>
<td>11.5</td>
<td>40, 40</td>
<td>10</td>
<td>7</td>
<td>0.5</td>
<td>HI</td>
<td>Jumping</td>
<td>TBAD FT</td>
</tr>
<tr>
<td>Hessian et al.</td>
<td>12.2</td>
<td>35, 35</td>
<td>11.6</td>
<td>8</td>
<td>1.75</td>
<td>HI</td>
<td>Athletics</td>
<td>TBAD LT, FN</td>
</tr>
<tr>
<td>Kotz et al.</td>
<td>15-25</td>
<td>20, 20</td>
<td>16-17</td>
<td>0</td>
<td>2</td>
<td>M-H</td>
<td>Tennis</td>
<td>TBAD LT, FN</td>
</tr>
<tr>
<td>Dufour et al.</td>
<td>17</td>
<td>20, 20</td>
<td>16-17</td>
<td>0</td>
<td>2</td>
<td>M-H</td>
<td>Running</td>
<td>TBAD LT, FN</td>
</tr>
<tr>
<td>Nicholas et al.</td>
<td>17.5</td>
<td>50, 50</td>
<td>16</td>
<td>12</td>
<td>1.7</td>
<td>M</td>
<td>Weight</td>
<td>TBAD FT</td>
</tr>
<tr>
<td>Hing and Karuppu</td>
<td>18</td>
<td>10, 10</td>
<td>8-9</td>
<td>10-11y</td>
<td>10-24</td>
<td>M-H</td>
<td>Gymnastics</td>
<td>TBAD LT, FN</td>
</tr>
<tr>
<td>Taaffe et al.</td>
<td>18.3</td>
<td>30, 30</td>
<td>7.5</td>
<td>6</td>
<td>22</td>
<td>M-H</td>
<td>Gymnastics</td>
<td>TBAD LT, FN</td>
</tr>
</tbody>
</table>

a Planning.

am = amenorrhea; BA = bone area; BMC = bone mineral content; BMD = bone mineral density; BW = bone weight; C = secondary centers; DI = diurnal training; E = exercise intensity; F = female; H = high intensity; HI = high intensity; M = moderate intensity; M2 = second measurement; M3 = third measurement; OB = obesity; OI = osteoporosis; R = relative radius; TB = total body; WD = weight lifting; Z = section modulus (bending strength); ± indicates increase; + indicates no effect.
Meta-analysis of walking for preservation of bone mineral density in postmenopausal women

Marrissa Martyn-St James \textsuperscript{a,*}, Sean Carroll \textsuperscript{b}

Bone 43 (2008) 521–531

- regular walking has no significant effect on preservation of BMD at the spine in postmenopausal women,
- whilst significant positive effects at femoral neck are evident
- other forms of exercise that provide greater targeted skeletal loading may be required to preserve bone mineral density in this population.
- exercise should have a high impact, i.e. able to condition an important ground reaction, be repeated for brief cycles and repeated several times daily (C).

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{walking.png}
\caption{Meta-analysis of walking for preservation of bone mineral density in postmenopausal women.}
\end{figure}
• regular high intensity resistance training is appropriate exercise therapy in maintaining lumbar spine BMD amongst postmenopausal women although the inclusion of other weight bearing activities may also be necessary to best augment hip BMD without other therapeutic agents. (A)

• exercise is capable of modifying bone mass and geometry in postmenopausal women, adaptations that may theoretically improve bone strength

• training effects appear to be modest, site-specific, and primarily affect cortical rather than trabecular components of bone. (B)
Tai chi for osteoporosis: a systematic review

M. S. Lee · M. H. Pittler · B.-C. Shin · E. Ernst

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Tai chi</th>
<th>No treatment</th>
<th>Mean Difference IV, Random, 95% CI</th>
<th>Mean Difference IV, Random, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chan 2004</td>
<td>0.001</td>
<td>0.16</td>
<td>54 -0.007 0.15 49 45.5% 0.01 [-0.05, 0.07]</td>
<td></td>
</tr>
<tr>
<td>Zhou 2004*</td>
<td>0.019</td>
<td>0.16</td>
<td>12 -0.019 0.16 12 10.0% 0.04 [-0.09, 0.17]</td>
<td></td>
</tr>
<tr>
<td>Zhou 2005</td>
<td>0.035</td>
<td>0.15</td>
<td>12 -0.019 0.16 12 10.6% 0.05 [-0.07, 0.18]</td>
<td></td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>0.014</td>
<td>0.1</td>
<td>16 -0.009 0.1 16 34.0% 0.02 [-0.05, 0.09]</td>
<td></td>
</tr>
</tbody>
</table>

Test for heterogeneity: Chi² = 0.52, df = 3 (P = 0.91), I² = 0%
Test for overall effect: Z = 1.02 (P = 0.31)

Favours no treatment
Favours tai chi

Fig. 2 Meta-analysis of tai chi for bone mineral density (mg/cm²) at spine compared with no-treatment control in postmenopausal women. *This study (Zhou 2004) tested two different types of tai chi
Effect of whole-body vibration on BMD: a systematic review and meta-analysis

L E Slatkovska • S M H Alibhai • J Beyene • A M Cheung

A. Vibration

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Vibration</th>
<th>Control</th>
<th>Mean (SD)</th>
<th>Mean (SD)</th>
<th>Total Weight</th>
<th>Mean Difference</th>
<th>IV, Fixed, 95% CI</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voskoboev</td>
<td>0.009</td>
<td>0.019</td>
<td>25</td>
<td>0.000</td>
<td>0.000</td>
<td>25</td>
<td>-0.01 (-0.02, 0.00)</td>
<td>2004</td>
</tr>
<tr>
<td>Rubin</td>
<td>-0.002</td>
<td>0.048</td>
<td>19</td>
<td>0.000</td>
<td>0.002</td>
<td>14</td>
<td>-0.01 (-0.02, 0.00)</td>
<td>2004</td>
</tr>
<tr>
<td>Gold</td>
<td>0.02</td>
<td>0.048</td>
<td>14</td>
<td>-3.02</td>
<td>0.029</td>
<td>14</td>
<td>0.05 (0.01, 0.09)</td>
<td>2007</td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>58</td>
<td>73</td>
<td>100.0%</td>
<td>0.01</td>
<td>0.02</td>
<td></td>
<td>-0.05 (-0.01, 0.00)</td>
<td></td>
</tr>
<tr>
<td>Homogeneity: Ch^2 = 3.21, df = 2, P = 0.22, I^2 = 25%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Test for overall effect: Z = 4.27 (P = 0.0001)

B. Control

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Vibration</th>
<th>Control</th>
<th>Mean (SD)</th>
<th>Mean (SD)</th>
<th>Total Weight</th>
<th>Mean Difference</th>
<th>IV, Fixed, 95% CI</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voskoboev</td>
<td>0.009</td>
<td>0.019</td>
<td>25</td>
<td>0.000</td>
<td>0.000</td>
<td>25</td>
<td>-0.01 (-0.02, 0.00)</td>
<td>2004</td>
</tr>
<tr>
<td>Rubin</td>
<td>-0.004</td>
<td>0.057</td>
<td>19</td>
<td>0.000</td>
<td>0.002</td>
<td>14</td>
<td>-0.01 (-0.02, 0.00)</td>
<td>2004</td>
</tr>
<tr>
<td>Inamoto</td>
<td>-0.001</td>
<td>0.057</td>
<td>14</td>
<td>-0.01</td>
<td>0.029</td>
<td>14</td>
<td>-0.00 (-0.02, 0.00)</td>
<td>2005</td>
</tr>
<tr>
<td>Gold</td>
<td>0.01</td>
<td>0.057</td>
<td>14</td>
<td>-0.01</td>
<td>0.029</td>
<td>14</td>
<td>0.00 (-0.03, 0.03)</td>
<td>2006</td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>58</td>
<td>98</td>
<td>100.0%</td>
<td>0.00</td>
<td>0.01</td>
<td></td>
<td>-0.09 (-0.91, 0.00)</td>
<td></td>
</tr>
<tr>
<td>Homogeneity: Ch^2 = 1.40, df = 3, P = 0.60; I^2 = 0%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Test for overall effect: Z = 0.78 (P = 0.40)

REVIEW

DOI 10.1007/s00198-010-1226-z

1/6/2014
Exercise beyond BMD................
reduces fracture risk
The Association Between Physical Activity and Osteoporotic Fractures: A Review of the Evidence and Implications for Future Research

ALIREZA MOAYYERI, MD, MPH

- As the medical literature lacks direct evidence from randomized controlled trials (RCTs) with fracture end points, a meta-analysis of 13 prospective cohort studies with hip fracture end point is included.

- Moderate-to-vigorous physical activity is associated with a hip fracture risk reduction of 38% (95% CI, 31-44%), in women (C).


Influence of Physical Activity on Vertebral Deformity in Men and Women: Results from the European Vertebral Osteoporosis Study

A.J. SILMAN,1 T.W. O’NEILL,2 C. COOPER,2 J. KANIS,3 D. FELSENBERG,4 and THE EUROPEAN VERTEBRAL OSTEOPOROSIS STUDY GROUP5

- EVOS (European Vertebral Osteoporosis Study) included 6,646 women 50–79 yrs, 884 of them had a vertebral deformity, showed that walking or cycling with duration more than 30 minutes daily is associated with 20% reduction of risk of vertebral deformity compared with sedentary women. (B)

Possible synergies

• Exercise plus drugs

• Exercise plus calcium
Exercise and calcium act synergistically on bone?

DOI 10.1007/s00223-008-9105-x

CLINICAL INVESTIGATIONS

Influence of Calcium Intake and Physical Activity on Proximal Femur Bone Mass and Structure Among Pre- and Postmenopausal Women. A 10-Year Prospective Study

Kirsti Uusi-Rasi · Harri Sievänen · Matti Pasanen · Thomas J. Beck · Pekka Kannus

Some say yes, some no:
This is a question that has not been intensively explored.
→ please read Prince’s study, Chinese study etc.
PART III

CALCIUM, VITAMIN D, AND VITAMIN D ANALOGUES IN PREVENTION OF OSTEOPOOROSIS (AND MANAGEMENT), FALLS & FRACTURES
Calcium – vitamin D – management of osteoporosis

Use of calcium or calcium in combination with vitamin D supplementation to prevent fractures and bone loss in people aged 50 years and older: a meta-analysis

Vitamin D – Falls prevention
Meta-analysis

Therapeutic Options

- **Antiresorptive Therapy**
  - Calcitonin
  - Raloxifene
  - Bisphosphonates
    - Alendronate
    - Risedronate
    - Ibandronate
    - Zolendronic Acid
  - Denosumab

- **Anabolic Therapy**
  - Parathyroid hormone (1,84 PTH)
  - Teriparatide (1,34 PTH)

*Strontium ranelate (??)*
PART IV
FALLS

The dual role of Rehabilitation

picture modified with permission from:
RISK FACTORS FOR FALLING

can be classified as either:

- **Intrinsic**
- **Extrinsic**
- **Exposure to risk**

<table>
<thead>
<tr>
<th>Nonmodifiable factors</th>
<th>Intrinsic Risk Factors</th>
<th>Extrinsic Risk Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Gender</td>
<td>Medications/side effects</td>
</tr>
<tr>
<td>Gender</td>
<td>Race</td>
<td>Fall hazards</td>
</tr>
<tr>
<td>Chronic disease: physical</td>
<td></td>
<td>Footwear</td>
</tr>
<tr>
<td>Chronic disease: psychological</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Modifiable factors</th>
<th>Acute illness</th>
<th>Incontinence</th>
<th>History of falls</th>
<th>Gait and mobility impairment</th>
<th>Visual/Sensory deficits</th>
<th>Medications/side effects</th>
<th>Fall hazards</th>
<th>Footwear</th>
</tr>
</thead>
</table>

Targeting the modifiable risk factors for falling

- **Low strength and power**
- Medical condition
- Medications
- **Incontinence**
- Cognitive impairment
- **Balance/gait**
- **Postural hypotension**
- Vision/hearing
- Foot care
- Poor housing
- **Depression**
- Previous falls
- **Fear of falling**
- Functional capacity
- Poor heating
- Poor diet

Integrated prevention and detection solutions tailored to the population and risk factors associated with falls

2.3.3 Functional View
Five main services are provided by the iWalker platform. Three are related to elderly/impaired assistance. The fourth is used for data logging and the fifth is for communication purposes. Assistance tasks should be planned by a physiotherapist. Services provided are:
1. Active motor assistance to compensate lack of muscle force on climbs;
2. Brake assistance to compensate lack muscle force on descents;
3. Active differential assistance to compensate unbalanced muscle force, and finally:
4. Recording of sensor measurements and actuators activities for later evaluation (left and right hand forces, normal forces, hand-brake status, tilt and odometry);
5. Sending data and status to networked devices. Data related to user activity, forces measured and iWalker status will be published to IDF present devices and remote servers.

Expected outcomes

- **I-DONT-FALL Configurable Platform** for prevention, detection and management of falls improving the QoL of elderly and/or patients susceptible to falls
- Results of **standard tests for fallers** (e.g. Tinetti)
- **Best Practices** associated with fall management solutions development and deployment
- **Guidelines** on how to personalise the cares and blueprints on how to deploy and customise effectively ICT based solutions
- **New Medical Knowledge** on effectiveness, sustainability and wider applicability/use of fall management solutions
Improving risk factors – duration vs. outcome

- Gait (8 weeks)
- Balance (Static 8 weeks + Dynamic 8 weeks)
- Muscle strength (8-12 weeks)
- Muscle power (12 weeks)
- Endurance (26 weeks)
- Transfer (6 months)
- Postural hypotension (24 weeks)
- Bone strength (1 year for femur and lumbar spine)

(Skelton and McLaughlin, 1996)
In the elderly people the **strongest single risk factor for fracture** is falling and not osteoporosis.


**Recommended Components of Clinical Assessment and Management for Older Persons Living in the Community Who Are at Risk for Falling.**

**Assessment and Risk Factor**

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Circumstances of previous falls</td>
<td>Changes in environment and activity to reduce the likelihood of future falls</td>
</tr>
<tr>
<td>Medication use (e.g., benzodiazepines, other sleep-inducing medications, anticholinergics, antidepressants)</td>
<td>Review and reduction of medications</td>
</tr>
<tr>
<td>Falls or near falls</td>
<td></td>
</tr>
<tr>
<td>Vision</td>
<td>Amelioration of visual acuity and distance visual field assessment while avoiding referral to an ophthalmologist</td>
</tr>
<tr>
<td>Previous fall history</td>
<td></td>
</tr>
<tr>
<td>Previous use of antidepressants</td>
<td></td>
</tr>
<tr>
<td>Previous use of other medications (e.g., benzodiazepines)</td>
<td></td>
</tr>
<tr>
<td>Examination of gait</td>
<td></td>
</tr>
<tr>
<td>Balance and posture</td>
<td></td>
</tr>
<tr>
<td>Targeted gait examination</td>
<td></td>
</tr>
<tr>
<td>Targeted upper extremity examination</td>
<td></td>
</tr>
<tr>
<td>Targeted lower extremity examination</td>
<td></td>
</tr>
<tr>
<td>Targeted multidimensional examination of function and range of motion</td>
<td></td>
</tr>
<tr>
<td>Targeted multidimensional examination of function and range of motion</td>
<td></td>
</tr>
<tr>
<td>Targeted psychosocial evaluation</td>
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<tr>
<td>Risk factors</td>
<td></td>
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<tr>
<td>Management</td>
<td></td>
</tr>
<tr>
<td>Changes in environment and activity to reduce the likelihood of future falls</td>
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<td>Review and reduction of medications</td>
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<td>Balance and posture</td>
<td></td>
</tr>
<tr>
<td>Targeted gait examination</td>
<td></td>
</tr>
<tr>
<td>Targeted upper extremity examination</td>
<td></td>
</tr>
<tr>
<td>Targeted lower extremity examination</td>
<td></td>
</tr>
<tr>
<td>Targeted multidimensional examination of function and range of motion</td>
<td></td>
</tr>
<tr>
<td>Targeted multidimensional examination of function and range of motion</td>
<td></td>
</tr>
<tr>
<td>Targeted psychosocial evaluation</td>
<td></td>
</tr>
<tr>
<td>Risk factors</td>
<td></td>
</tr>
</tbody>
</table>

Tai-Chi

- Several reviews and studies claimed that tai chi is beneficial for balance, muscle strength and fall prevention.
- Wolf et al. found a reduction in the rate of falls by approximately 50% (RR: 0.51; 95%CI: 0.36–0.73), while falls contribute significantly to the pathogenesis of non vertebral fractures in subjects with low BMD.
- Consequently, tai chi may play an important role in the prevention of fractures due to osteoporosis as well as in musculoskeletal rehabilitation in osteoporosis.
- Future RCTs investigating the effects of tai chi should, therefore, focus on balance, falls and fall-related fractures.
In this study, 111 studies (totaling 55,303 participants) were included. The results showed that multiple-component group exercise reduces the rate of falls and the risk of falling (RR 0.83, 95% CI 0.72-0.97). Tai Chi as a group exercise also reduces the rate of falls and the risk of falling (RR 0.65, 95% CI 0.51-0.82). Individually prescribed exercise carried out at home reduces the rate of falls and the risk of falling (RR 0.77, 95% CI 0.61-0.97), but there is no evidence to support this intervention in people with severe visual impairment or mobility problems after a stroke, Parkinson's disease, or after a hip fracture. (A)


**CONCLUSION:** Functional-task exercises are more effective than resistance exercises at improving functional task performance in healthy elderly women and may have an important role in helping them maintain an independent lifestyle.
PART V

REHABILITATION AFTER FRACTURES

Rehabilitation after surgical stabilization of the hip fracture

• Operative treatment has proven necessary to optimize post-injury mobility and functional recovery in the majority of hip fracture victims.¹

• Rehabilitation after surgical stabilization of the hip fracture is crucial to regain prefracture function and to avoid long-term institutionalization that can be as high as 25% 1 year postfracture.²

### Review: Mobilization strategies after hip fracture surgery in adults

**Comparison:** Supervised intensive physical therapy and exercise training versus low-intensity home exercise.

**Outcomes:** Quality of life at 6 months.

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>Intensive exercise N</th>
<th>Intensive exercise Mean(SD)</th>
<th>Home exercise N</th>
<th>Home exercise Mean(SD)</th>
<th>Mean Difference (N Fixed 95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 SF-36 Physical Function subscale (0 to 100; best)</td>
<td>41</td>
<td>74 (21)</td>
<td>42</td>
<td>63 (27)</td>
<td>11.00 [4.42, 21.58]</td>
</tr>
<tr>
<td>Bender 2004</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 SF-36 Social function subscale (0 to 100; best)</td>
<td>41</td>
<td>92 (14)</td>
<td>42</td>
<td>87 (23)</td>
<td>5.00 [-2.76, 13.76]</td>
</tr>
<tr>
<td>Bender 2004</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Hip Rating Questionnaire Score (0 to 100; best)</td>
<td>41</td>
<td>84 (11)</td>
<td>42</td>
<td>85 (14)</td>
<td>4.00 [-1.73, 8.73]</td>
</tr>
<tr>
<td>Bender 2004</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Aquatic Exercises**

- A.
- B.
- C.
- D.
Rehabilitation after falls and fractures

Y. Dionysiotis, I.A. Dontas, D. Economopoulos, G.P. Lyritis

Laboratory for Research of the Musculoskeletal System, University of Athens, KAT Hospital, Kifissia, Greece

Abstract

Falls are one of the most common geriatric problems threatening the independence of older persons. Elderly patients tend to fall more often and have a greater tendency to fracture their bones. Fractures occur particularly in osteoporotic people due to increased bone fragility, resulting in considerable reduction of quality of life, morbidity, and mortality. This article provides information for the rehabilitation of osteoporotic fractures pertaining to the rehabilitation of the fractured patient, based on personal experience and literature. It also outlines a suggested effective and efficient clinical strategy approach for preventing falls in individual patients.

Rehabilitation after vertebral compression fractures

- Improve any faults in posture
- If beyond correction, consider a back support to decrease ligament stretch
- Avoid activities that increase vertebral compression forces
- Prescribe a sound, ongoing, therapeutic exercise program:
  - Strengthening exercises for the trunk, pelvis, thighs, and lower extremities.
  - Emphasis should be on trunk extension and avoidance of trunk flexion and rotation.
  - Tai Chi activities have been shown to be beneficial at increasing strength, balance, and posture.
  - Gentle aerobic activity, including walking, even with the use of a wheeled walker with hand brakes, may improve mobility.
  - Exercises should be done for a minimum of 30 minutes at least 3 times weekly.
- Start appropriate medications, as indicated
- Use acupuncture, biofeedback, relaxation therapy, and guided visualization as appropriate
- Evaluate and treat psychologic and social consequences
- Consider support groups and self-management skill training

National Osteoporosis Foundation, Washington, DC 20037.29
• Buoyancy reduces stress on joints and muscles and enables greater range of movement via supporting the weight of the body, changing depth allows for progression of resistance and warm water increases muscle efficiency (Skelton and Dinan 1999).

Spinal Orthoses/Braces

• Bracing is commonly used in acute nonsurgical management.

• Spinal orthoses help control pain and promote healing by stabilizing the spine. By restraining forward flexion, they reduce the load on the anterior column and the vertebral body.

• Lumbar corsets are not recommended as they place additional stress on fractures at the thoracolumbar junction.\(^1\)

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Pfeifer M, Kohlwey L, Begerow B, Minne HW. The Orthoses Spined and Spinedmed active Improve Posture, Trunk Muscle Strength, and Quality of Life in Postmenopausal Women with Spinal Osteoporosis: A Controlled, Randomized, and Prospective Clinical Trial. World Osteoporosis Congress of the International Osteoporosis Foundation ("IOF") Toronto, Canada, June 2006; Poster P384MO

BASED ON BIOFEEDBACK THEORY

BASED ON GATE CONTROL THEORY

Spinomed®, With permission from Medi Bayreuth, Germany
Effects of a New Spinal Orthosis on Posture, Trunk Strength, and Quality of Life in Women with Postmenopausal Osteoporosis


Osteomed®
Thämert Orthopädische Hilfsmittel GmbH & Co.
Spinal orthoses - pain

ORIGINAL REPORT

EFFICACY OF A FLEXIBLE ORTHOTIC DEVICE IN PATIENTS WITH OSTEOPOROSIS ON PAIN AND ACTIVITY OF DAILY LIVING

Matthias Fink¹, Banu Kalpakcioglu², Matthias Karst³ and Michael Bernateck²

From the Departments of ¹Physical Medicine and Rehabilitation and ²Anaesthesiology and Pain Medicine, Hannover Medical School, Hannover, Germany and ³Hasakli Training and Research School, Istanbul, Turkey

Pain efficacy is a usual endpoint in many publications about orthotics

- By far the most frequent complaint of patients with osteoporosis is pain upon standing and under physical stress, particularly when bending forward.

the problem of compliance

Table 3. Compliance data for osteoporosis medications (compliance data for daily and weekly bisphosphonates are presented in Table 4).

<table>
<thead>
<tr>
<th>Reference</th>
<th>Medication</th>
<th>Number</th>
<th>Mean MPR</th>
<th>Time period</th>
</tr>
</thead>
<tbody>
<tr>
<td>[7]</td>
<td>Raloxifene</td>
<td>1,314</td>
<td>0.66</td>
<td>1 year</td>
</tr>
<tr>
<td></td>
<td>Bisphosphonates</td>
<td>3,720</td>
<td>0.68</td>
<td></td>
</tr>
<tr>
<td></td>
<td>HRT</td>
<td>46,119</td>
<td>0.73</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 HRTs</td>
<td>6,766</td>
<td>0.81</td>
<td></td>
</tr>
<tr>
<td>[19]</td>
<td>Combined alendronate, risendronate; HRT</td>
<td>38,120</td>
<td>0.66</td>
<td>Average follow-up 1.7 years</td>
</tr>
<tr>
<td>[8]</td>
<td>Combined alendronate, risendronate; etidronate, etidronate/calcium, calcitonin salmon nasal spray, conjugated estrogens, estradiol valerate, or ethinyl estradiol</td>
<td>11,249</td>
<td>0.79</td>
<td>Average follow-up 2 years</td>
</tr>
<tr>
<td>[9]</td>
<td>Alendronate, etidronate, calcitonin, or HRT</td>
<td>91</td>
<td>0.79</td>
<td>Mean of 590 days (participants)</td>
</tr>
<tr>
<td>[25]</td>
<td>Alendronate, risendronate</td>
<td>2,741</td>
<td>0.61</td>
<td>1 year</td>
</tr>
<tr>
<td>[26]</td>
<td>GPRD</td>
<td>7,567</td>
<td>0.74</td>
<td>1 year</td>
</tr>
<tr>
<td></td>
<td>MEDPLUS</td>
<td>5,962</td>
<td>0.68</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DIN</td>
<td>1,891</td>
<td>0.59</td>
<td></td>
</tr>
<tr>
<td>[27]</td>
<td>THALES</td>
<td>5,352</td>
<td>0.58</td>
<td>1 year</td>
</tr>
</tbody>
</table>


Compliance

- The compliance of wearing orthoses for 6 months was 66%.
Hip protectors


PART VI
WHAT ABOUT DISABLED POPULATIONS
Bone loss in paraplegia. A diagnostic and therapeutic protocol.


Bone loss in paraplegia. a diagnostic and therapeutic protocol.

Yannis Dionysiou
Rehabilitation Department, Rhodes General Hospital, Rhodes, Greece.

METHODS

Diagnostie evaluation of bone loss should include:
- A detailed history of previous fractures, trauma to the lower extremities, and use of corticosteroids.
- Dual-energy X-ray absorptiometry (DEXA) scans to assess bone mineral density (BMD) at a minimum of the lumbar spine and total hip.
- Laboratory tests to evaluate bone turnover markers (e.g., serum intact procollagen type I N-terminal propeptide [PINP], C-telopeptide of type I collagen [CTX-1]).
- Magnetic resonance imaging (MRI) to assess bone marrow edema and bone loss in the femoral neck.
- Radiographs to evaluate bone structure and morphology.

RESULTS

Diagnostie and therapeutic options for bone loss in paraplegia include:
- Pharmacological interventions (e.g., bisphosphonates, denosumab).
- Intraosseous bone grafting or platelet-rich plasma.
- Physical therapy and physiotherapy to improve muscle strength and function.
- Adaptive equipment to assist with mobility and daily activities.
- Counseling and psychological support for patients and their families.

CONCLUSION

Bone loss in paraplegia requires a multidisciplinary approach involving bone health experts, orthopedic surgeons, rehabilitation specialists, and physiotherapists to effectively manage and prevent bone loss.

REFERENCES


International Journal of General Medicine

Bone loss and fractures in multiple sclerosis: focus on epidemiologic and physiopathological features

Yannis Dionysiou
Rehabilitation Department, Physical and Social Rehabilitation Center, Amyntas, Florina, Greece

Abstract: Multiple sclerosis (MS) affects the central nervous system leading to disability and is complicated by bone loss and fractures. Despite the acceptance of osteoporosis and fractures as two major public health problems, in people with MS the mechanisms have not been investigated adequately. Physicians and patients usually focus on the major cause of disability and neglect the multiple risk factors for osteoporosis and fractures in this specific population. This review...
thank you for your participation