WORKSHOP

Modern Rehabilitation in Osteoporosis, Falls & Fractures

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19th European Congress of PRM

Disclosure statement

There are no relevant conflicts of interest to disclose

SUMMARY

- INTRODUCTION
- EXERCISE
- CALCIUM
- FALLS
- REHABILITATION AFTER FRACTURES
- DISABLED POPOULATIONS

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Clinical Medicine Insights: Arthritis and Musculoskeletal Disorders

Modern Rehabilitation in Osteoporosis, Falls, and Fractures

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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 higher risk for osteoporotic fractures, particular attention should be paid to improving balance – the most important element in falls prevention. Given the close interaction between osteoporosis 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 spinal orthosis helps to reduce pain and improve posture. Vibration platforms are used in rehabilitation of osteoporosis, based on the concept that noninvasive, short-duration, mechanical stimulation could have an impact on osteoporosis risk. Pharmacologic therapy should be added for those at high risk of fracture, and vitamin D/calcium 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, orthosis, 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**

REHA + OTHER SPECIALTIES

REHA + OTHER SPECIALTIES

REHA + OTHER SPECIALTIES

REHA

REHA + Orthopaedics (surgical treatment & kyphoplasty)

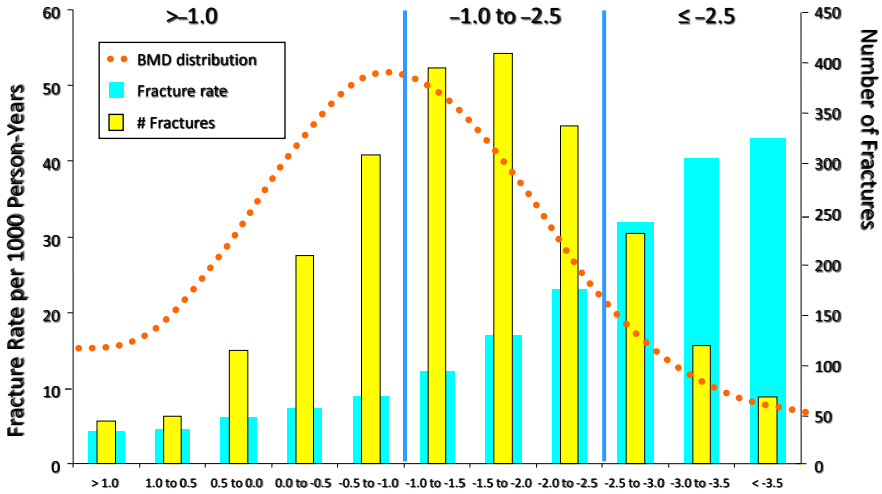
Answer to the question: because osteoporosis is a disease leading to disabilities
Rehabilitation Medicine optimizes functioning & promotes participation

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



Siris ES, et al *JAMA*. 2001;286:2815-2828.

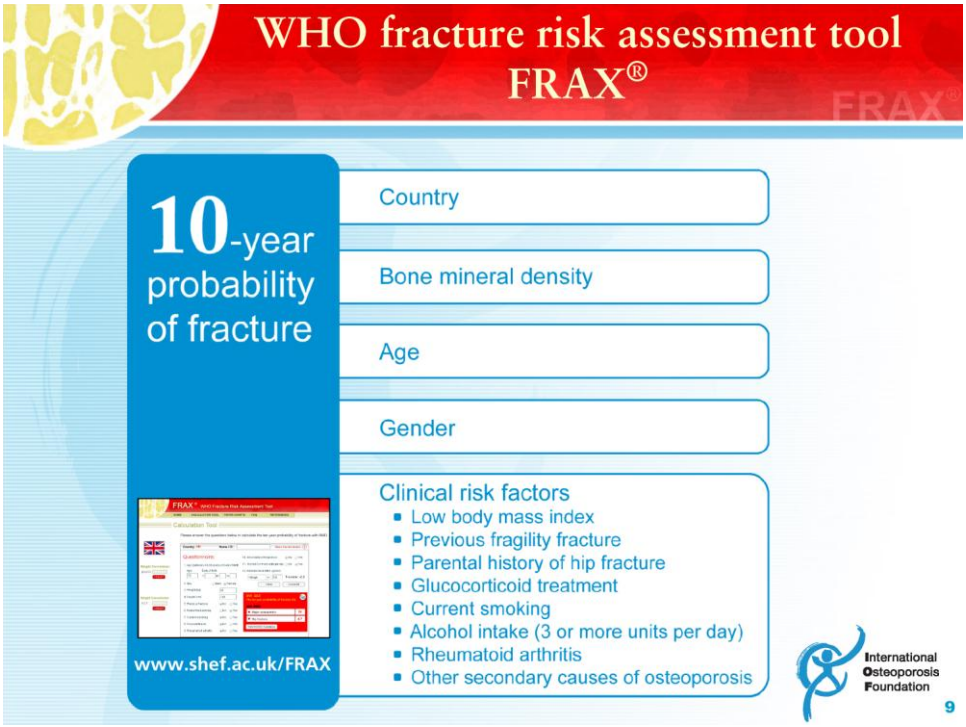
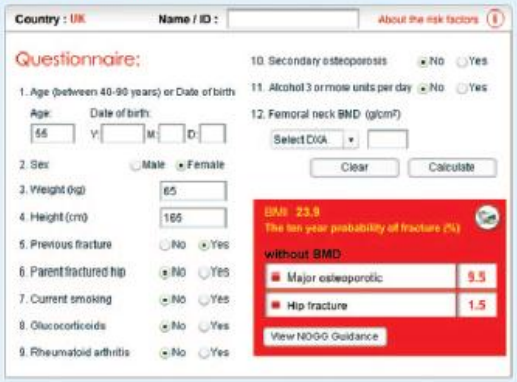


Figure 3
FRAX® calculation tool - UK



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

International Osteoporosis Foundation

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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

Järvinen TL, Sievänen H, Khan KM, Heinonen A, Kannus P. BMJ. 2008 Jan 19;336(7636):124-6.

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

Kannus P, Niemi S, Parkkari J, Palvanen M, Heinonen A, Sievanen H, et al. Why is the age-standardized incidence of low-trauma fractures rising in many elderly populations? J Bone Miner Res 2002;17:1363-7.
Kannus P, Sievanen H, Palvanen M, Jarvinen T, Parkkari J. Prevention of falls and consequent injuries in elderly people. Lancet 2005;366:1885-93.

- 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.

Robinovitch SN, Inkster L, Maurer J, Warnick B. Strategies for avoiding hip impact during sideways falls. J Bone Miner Res 2003;18:1267-73.

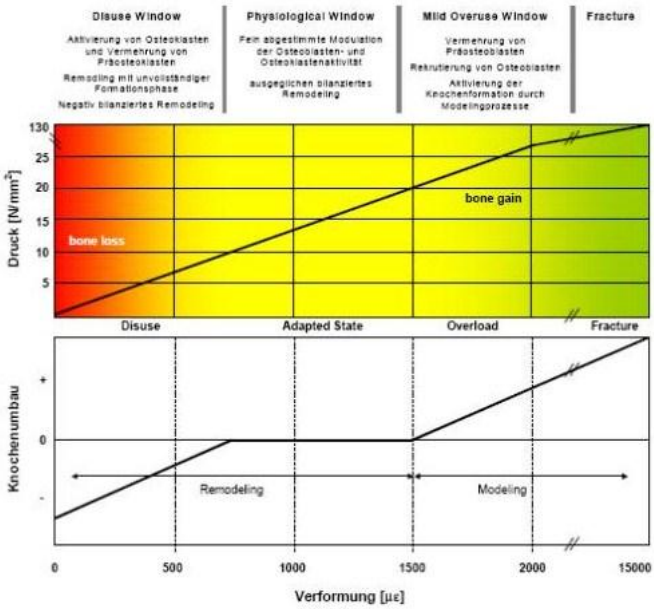
Frost HM. The mechanostat. Anat Rec 1987; 219:1-9.

- **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"

Jee WS. Harold M. Frost, M.D., D.Sc. (hon) -- one man's association. J Musculoskelet Neuronal Interact. 2006 Apr-Jun;6(2):113-21.

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

Frost HM. The mechanostat: a proposed pathogenic mechanism of osteoporoses and the bone mass effects of mechanical and nonmechanical agents. Bone Miner. 1987 Apr;2(2):73-85.

PART II

EXERCISE FOR PREVENTION AND MANAGEMENT OF OSTEOPOROSIS AND PREVENTION OF FRACTURES

M. Pfeifer[1]
B. Begerow[1]
H. W. Minne[1,2]

Rehabilitation bei Osteoporose

Rehabilitation in osteoporosis

Institut
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[2] Klinik „Der Fürstenhof" (Ärztlicher Direktor: Prof. Dr. med. H. W. Minne), Bad Pyrmont

Dtsch Med Wochenschr 2003; 128: 941–945 · © Georg Thieme Verlag Stuttgart · New York · ISSN 0012-0472

Tab. 1 Methoden der Krankengymnastik bei Osteoporose (1).

- Bobath zur Muskelstabilisierung
- Stemmführung nach Brunkow zur Ganzkörperkräftigung
- Funktionelle Bewegungslehre nach Klein-Vogelbach als ADL-Training
- Manuelle Therapie zur Erhöhung der Flexibilität
- Cyriax zur Schmerzlinderung

Tab. 3 Physikalische Therapiemaßnahmen bei Osteoporose (13).

- Moorpackungen und/oder –bäder
- Solewannen- und Kohlensäureeisenbäder
- Stangerbäder
- CO_2-Quellgasbäder
- leichte Streich- oder Bürstenmassagen

bei zusätzlicher Gelenkproblematik:

- Ultraschall
- Interferenz
- Iontophorese

REVIEW ARTICLE

Sports Med 2005; 35 (9): 779-830
0112-1642/05/0009-0779/$34.95/0

Physical Activity in the Prevention and Amelioration of Osteoporosis in Women

Interaction of Mechanical, Hormonal and Dietary Factors

Katarina T. Borer

Division of Kinesiology, The University of Michigan, Ann Arbor, Michigan, USA

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

Study	Age (y)	No. of subjects	Age of onset of training (y)	Duration of training	Volume of training (h/wk)	Intensity (%1RM)	Activity	Outcomes
McKay et al.[330]	9–10.5	63E, 81C	7–9	8mo	1	HI	Jumping	↑BMD FT
Fuchs et al.[324]	8.1	45E, 44C	7.5	7mo	2	HI	Jumping	↑BMC, ↑BMD LS, ↑BMC, ↑BA FN
Fuchs and Snow[325]	8.7	37E, 37C	8.1	7mo det	NR	NR	Retention	↑BMC, ↑BA FN
Haapasalo et al.[327]	9.5–15.5	91E, 58C	6–8	2.5–4y	2–5	M-HI	Tennis	↑BMD Hp, HS, Rd, LS
Morris et al.[331]	10.4	38E, 3C	9.5	10mo	1.5	HI	Aerobics and wt train	↑BMC, ↑BMD TB, LS, FN, BW
MacKelvie et al.[329]	10.6	87E, 90C	10	7mo	1 (twice)	HI	Jumping	↑BMC LS, FN
Petit et al.[332]	10.7 11.3	43E, 25C 43E, 63C	10 10.5	7mo 7mo	0.5 0.5	HI HI	Jumping Jumping	↔BMD ↑BMD FN, FT, ↑BW, ↑Z
Laing et al.[326]	11	7E, 19C	5	3–6y	12–20	HI	Gymnastics	↑BMC LS, TB, ↑BMD TB, FT, Fp
Heinonen et al.[328]	12.2 14.5	25E, 33C 39E, 29C	11.4 13.7	9mo 9mo	1.75 1.75	HI HI	Aerobics Jumping	↑BMC LS, FN ↔BMC
Krahl et al.[148]	15–25	8E	10–20	>5y		M-HI	Tennis	↑BW Ud, M2
Blimkie et al.[316]	16.5–17.5	16E, 16C	16–17	6mo	2	M	Wt train	↔BMD
Duncan et al.[323]	17	60E, 15C		3–6y	8[a]–16	M-HI	Running Triathlon Cycling	↑BMD TB, LS, FN ↔BMD ↔BMD
Nichols et al.[322]	17.5	5E, 11C	16	15mo	1.7	M	Wt train	↑BMD FN
Helge and Kanstrup[333]	18	11E, 6C	8–9	10–11y	15–24	M-HI	Gymnastics	↑BMD LS, Fp, Rd, AM, OM
Taaffe et al.[336]	19.3	39E, 19C	7.5 12	6.5y 12y	22 22	M-HI M-HI	Gymnastics Swimming	↑BMD TB, LS, FN, FT ↔BMD

a Running.

AM = amenorrhoea; **BA** = bone area; **BMC** = bone mineral content; **BMD** = bone mineral density; **BW** = bone diameter; **C** = sedentary controls; **det** = detraining; **E** = exercising subjects; **FN** = femoral neck; **Fp** = proximal femur; **FT** = femoral trochanter; **HI** = high intensity; **Hp** = proximal humerus; **HS** = humeral shaft; **LS** = lumbar spine; **M** = moderate intensity; **M2** = second metacarpal; **NR** = not reported; **OM** = oligomenorrhoea; **Rd** = distal radius; **TB** = total body; **Ud** = distal ulna; **wt train** = weight training; **Z** = section modulus (bending strength); ↑ indicates increase; ↔ indicates no effect.

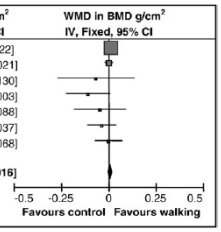
Meta-analysis of walking for preservation of bone mineral density in postmenopausal women

Marrissa Martyn-St James [a,*], Sean Carroll [b]

Bone 43 (2008) 521–531

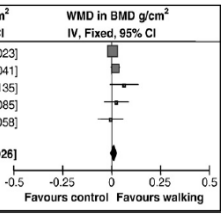
Study or Subgroup	Walking Mean	Walking SD	Walking Total	Control Mean	Control SD	Control Total	Weight	WMD in BMD g/cm² IV, Fixed, 95% CI
Brooke-Wavell 1997[11]	0.006	0.025	38	-0.005	0.026	40	73.4%	0.011 [0.000, 0.022]
Ebrahim 1997[24]	0.017	0.051	49	0.017	0.054	48	21.5%	0.000 [-0.021, 0.021]
Little 1992[25]	1.075	0.194	6	1.144	0.131	4	0.2%	-0.069 [-0.270, 0.130]
Martin (30mins) 1993[26]	0.992	0.125	20	1.103	0.162	10	0.7%	-0.111 [-0.225, 0.003]
Martin (40mins) 1993[26]	1.056	0.172	16	1.103	0.162	9	0.5%	-0.047 [-0.182, 0.088]
Wu (Isoflavones) 2006[27]	0.866	0.113	31	0.904	0.129	16	1.7%	-0.038 [-0.113, 0.037]
Wu (placebo) 2006[27]	0.901	0.099	31	0.904	0.129	17	1.9%	-0.003 [-0.074, 0.068]
Total (95% CI)			**191**			**144**	**100.0%**	**0.006 [-0.004, 0.016]**

Heterogeneity: Chi² = 7.60, df = 6 (P = 0.27); I² = 21%
Test for overall effect: Z = 1.25 (P = 0.21)



Study or Subgroup	Walking Mean	Walking SD	Walking Total	Control Mean	Control SD	Control Total	Weight	WMD in BMD g/cm² IV, Fixed, 95% CI
Brooke-Wavell 1997[11]	0.016	0.038	38	0.011	0.043	38	51.6%	0.005 [-0.013, 0.023]
Ebrahim 1997[24]	-0.002	0.042	49	-0.021	0.065	48	36.0%	0.019 [-0.003, 0.041]
Little 1992[25]	0.810	0.084	6	0.746	0.024	4	3.4%	0.064 [-0.007, 0.135]
Wu (Isoflavones) 2006[27]	0.696	0.093	31	0.672	0.104	16	4.7%	0.024 [-0.037, 0.085]
Wu (placebo) 2006[27]	0.667	0.110	31	0.672	0.104	17	4.4%	-0.005 [-0.068, 0.058]
Total (95% CI)			**155**			**123**	**100.0%**	**0.012 [-0.001, 0.026]**

Heterogeneity: Chi² = 3.44, df = 4 (P = 0.49); I² = 0%
Test for overall effect: Z = 1.87 (P = 0.06)



- 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).

Osteoporos Int (2006) 17: 1225–1240
DOI 10.1007/s00198-006-0083-4

ORIGINAL ARTICLE

High-intensity resistance training and postmenopausal bone loss: a meta-analysis

M. Martyn-St James · S. Carroll

- 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)

Osteoporos Int
DOI 10.1007/s00198-009-0967-1

REVIEW

The effects of exercise and physical activity participation on bone mass and geometry in postmenopausal women: a systematic review of pQCT studies

C. J. Hamilton · V. J. D. Swan · S. A. Jamal

- 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)

Osteoporos Int (2008) 19:139–146
DOI 10.1007/s00198-007-0486-x

REVIEW

Tai chi for osteoporosis: a systematic review

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

Study or Subgroup	Tai chi Mean	Tai chi SD	Tai chi Total	No treatment Mean	No treatment SD	No treatment Total	Weight	Mean Difference IV, Random, 95% CI
Chan 2004	0.001	0.16	54	-0.007	0.15	49	45.5%	0.01 [-0.05, 0.07]
Zhou 2004*	0.019	0.16	12	-0.019	0.16	12	10.0%	0.04 [-0.09, 0.17]
Zhou 2004*	0.035	0.15	12	-0.019	0.16	12	10.6%	0.05 [-0.07, 0.18]
Zhou 2005	0.014	0.1	16	-0.009	0.1	16	34.0%	0.02 [-0.05, 0.09]
Total (95% CI)			**94**			**89**	**100.0%**	**0.02 [-0.02, 0.06]**

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

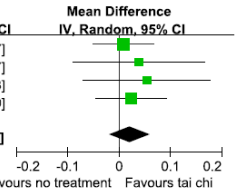


Fig. 2 Meta-analysis of tai chi for bone mineral density (mg/cm^2) at spine compared with no-treatment control in postmenopausal women. *This study (Zhou 2004) tested two different types of tai chi

Exercise for preventing and treating osteoporosis in postmenopausal women (Review)

Bonaiuti D, Shea B, Iovine R, Negrini S, Robinson V, Kemper HC, Wells G, Tugwell P, Cranney A

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Analysis 11.01. Comparison 11 Aerobic exercise vs control, Outcome 01 BMD Spine

Review: Exercise for preventing and treating osteoporosis in postmenopausal women
Comparison: 11 Aerobic exercise vs control
Outcome: 01 BMD Spine

Study	Treatment N	Treatment Mean(SD)	Control N	Control Mean(SD)	Weight (%)	Weighted Mean Difference (Fixed) 95% CI
Bravo 1996	52	0.55 (5.46)	54	-1.29 (6.09)	11.6	1.84 [-0.36, 4.04]
Chow 1987	16	0.07 (2.15)	15	-0.01 (2.04)	25.9	0.08 [-1.39, 1.55]
Grove 1992	5	1.71 (2.73)	5	-6.09 (4.83)	2.4	7.80 [2.94, 12.66]
Lau 1992	11	-1.90 (8.05)	12	-2.50 (7.90)	1.3	0.60 [-5.93, 7.13]
Lord 1996	68	1.07 (2.59)	70	0.36 (3.91)	46.3	0.71 [-0.39, 1.81]
Pruitt 1996	7	0.74 (5.90)	11	0.0 (5.48)	1.9	0.74 [-4.70, 6.18]
Smidt 1992	27	-1.79 (4.24)	22	-2.35 (4.00)	10.5	0.56 [-1.75, 2.87]
Total (95% CI)	**186**		**189**		**100.0**	**0.83 [0.08, 1.58]**

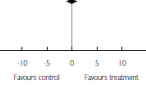
Test for heterogeneity chi-square=9.80 df=6 p=0.13 I² =38.8%
Test for overall effect z=2.17 p=0.03

Analysis 11.05. Comparison 11 Aerobic exercise vs control, Outcome 05 BMD Hip

Review: Exercise for preventing and treating osteoporosis in postmenopausal women
Comparison: 11 Aerobic exercise vs control
Outcome: 05 BMD Hip

Study	Treatment N	Treatment Mean(SD)	Control N	Control Mean(SD)	Weight (%)	Weighted Mean Difference (Fixed) 95% CI
Bravo 1996	52	0.27 (4.46)	54	-0.53 (4.67)	40.3	0.80 [-0.94, 2.54]
Lau 1992	11	-6.61 (12.80)	12	-1.10 (12.70)	1.1	-5.51 [-15.94, 4.92]
Lord 1996	68	1.52 (5.19)	70	3.12 (6.52)	31.6	-1.60 [-3.56, 0.36]
Pruitt 1996	8	-0.49 (5.08)	11	0.79 (3.72)	7.1	-1.28 [-5.43, 2.87]
Smidt 1992	22	1.06 (4.30)	27	-0.25 (4.51)	19.9	1.31 [-1.16, 3.78]
Total (95% CI)	**161**		**174**		**100.0**	**-0.07 [-1.18, 1.03]**

Test for heterogeneity chi-square=5.86 df=4 p=0.21 I² =31.8%
Test for overall effect z=0.13 p=0.9

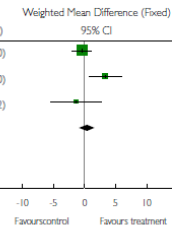


Analysis 10.02. Comparison 10 Exercise versus Control (resistance), Outcome 02 Bone mineral density (Hip)

Review: Exercise for preventing and treating osteoporosis in postmenopausal women
Comparison: 10 Exercise versus Control (resistance)
Outcome: 02 Bone mineral density (Hip)

Study	Treatment N	Mean(SD)	Control N	Mean(SD)	Weight (%)	Weighted Mean Difference (Fixed) 95% CI
Kerr 1996	25	0.0 (3.10)	25	0.40 (2.40)	67.4	-0.40 [-1.94, 1.14]
Nelson 1994	20	0.90 (4.50)	19	-2.50 (3.80)	23.4	3.40 [0.79, 6.01]
Pruitt 1996	8	-0.49 (5.08)	11	0.79 (3.72)	9.2	-1.28 [-5.43, 2.87]
Total (95% CI)	**53**		**55**		**100.0**	**0.41 [-0.85, 1.67]**

Test for heterogeneity chi-square=6.75 df=2 p=0.03 I^2 =70.4%
Test for overall effect z=0.63 p=0.5

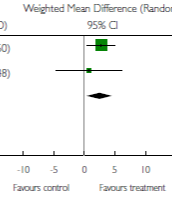


Analysis 10.01. Comparison 10 Exercise versus Control (resistance), Outcome 01 Bone mineral density (Spine)

Review: Exercise for preventing and treating osteoporosis in postmenopausal women
Comparison: 10 Exercise versus Control (resistance)
Outcome: 01 Bone mineral density (Spine)

Study	Treatment N	Mean(SD)	Control N	Mean(SD)	Weight (%)	Weighted Mean Difference (Random) 95% CI
Nelson 1994	20	1.00 (3.60)	19	-1.80 (3.50)	85.6	2.80 [0.57, 5.03]
Pruitt 1996	7	0.74 (5.90)	11	0.0 (5.48)	14.4	0.74 [-4.70, 6.18]
Total (95% CI)	**27**		**30**		**100.0**	**2.50 [0.44, 4.57]**

Test for heterogeneity chi-square=0.47 df=1 p=0.49 I^2 =0.0%
Test for overall effect z=2.38 p=0.02



Osteoporos Int (2010) 21:1969–1980
DOI 10.1007/s00198-010-1228-z

REVIEW

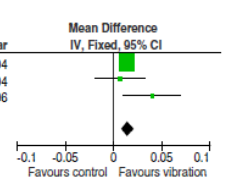
Effect of whole-body vibration on BMD: a systematic review and meta-analysis

L. Slatkovska · S. M. H. Alibhai · J. Beyene · A. M. Cheung

a

Study or Subgroup	Vibration Mean	Vibration SD	Vibration Total	Control Mean	Control SD	Control Total	Weight	Mean Difference IV, Fixed, 95% CI	Year
Verschueren	0.008	0.016	25	-0.006	0.013	45	87.8%	0.01 [0.01, 0.02]	2004
Rubin	-0.002	0.048	19	-0.009	0.029	14	6.8%	0.01 [-0.02, 0.03]	2004
Gusi	0.02	0.048	14	-0.02	0.029	14	5.5%	0.04 [0.01, 0.07]	2006
Total (95% CI)			**58**			**73**	**100.0%**	**0.01 [0.01, 0.02]**	

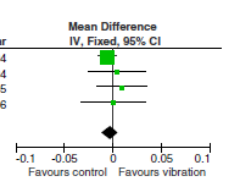
Heterogeneity: Chi^2 = 3.21, df = 2 (P = 0.20); I^2 = 38%
Test for overall effect: Z = 4.27 (P < 0.0001)



b

Study or Subgroup	Vibration Mean	Vibration SD	Vibration Total	Control Mean	Control SD	Control Total	Weight	Mean Difference IV, Fixed, 95% CI	Year
Verschueren	-0.003	0.019	25	0.003	0.02	45	75.7%	-0.01 [-0.02, 0.00]	2004
Rubin	-0.004	0.057	19	-0.008	0.029	14	7.6%	0.00 [-0.03, 0.03]	2004
Iwamoto	0.051	0.045	25	0.042	0.046	25	10.7%	0.01 [-0.02, 0.03]	2005
Gusi	-0.01	0.057	14	-0.01	0.029	14	6.0%	0.00 [-0.03, 0.03]	2006
Total (95% CI)			**83**			**98**	**100.0%**	**-0.00 [-0.01, 0.00]**	

Heterogeneity: Chi^2 = 1.49, df = 3 (P = 0.68); I^2 = 0%
Test for overall effect: Z = 0.78 (P = 0.44)



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NOVOTEC MEDICAL GmbH, Pforzheim GERMANY

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, MPHIL

- *As the medical literature lacks direct evidence from randomized controlled trials (RCT s)* ***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).

Moayyeri A. The association between physical activity and osteoporotic fractures: a review of the evidence and implications for future research. Ann Epidemiol. 2008 Nov;18(11):827-35.

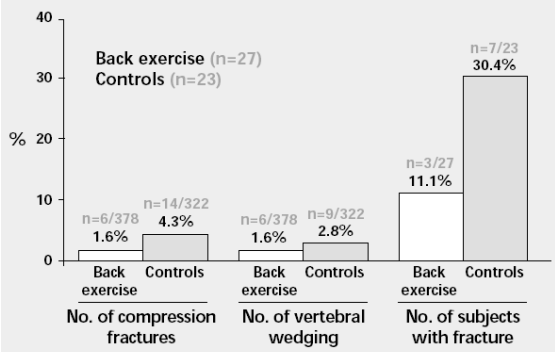
JOURNAL OF BONE AND MINERAL RESEARCH
Volume 12, Number 5, 1997
Blackwell Science, Inc.

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,[1] C. COOPER,[2] J. KANIS,[3] D. FELSENBERG,[4] and THE EUROPEAN VERTEBRAL OSTEOPOROSIS STUDY GROUP*

- 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)

- Sinaki M, et al. 2002. Stronger back muscles reduce the incidence of vertebral fractures: A prospective 10-year follow-up of postmenopausal women. Bone, 30(6):836-841. (E1)



Back stengthening exercise reduces vertebral fracture risk
This graph demonstrates the effect of back muscle strengthening on the rate of vertebral compression fractures and vertebral wedging in postmenopausal women. Ten years after a 2-year back exercise program, the proportion of women with fractures was only 11% in the exercise group as compared to 30% in the control group. Both wedging and vertebral compression fractures were significantly less in the back exercise group than the control group several years after the exercises were discontinued. (Modified from Ref.18, with permission)

Possible synergies

- Exercise plus drugs

- Exercise plus calcium

ELSEVIER

Bone 33 (2003) 132–143

BONE

www.elsevier.com/locate/bone

Effect of alendronate and exercise on bone and physical performance of postmenopausal women: a randomized controlled trial☆

K. Uusi-Rasi,[a,*] P. Kannus,[a,b] S. Cheng,[c] H. Sievänen,[a] M. Pasanen,[a] A. Heinonen,[a] A. Nenonen,[a,d] J. Halleen,[e] T. Fuerst,[f] H. Genant,[f] and I. Vuori[a]

Exercise and calcium act synergistically on bone?

Calcif Tissue Int (2008) 82:171–181
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.

Dionyssiotis *et al. BMC Women's Health* 2010, **10**:12
http://www.biomedcentral.com/1472-6874/10/12

BMC Women's Health

RESEARCH ARTICLE Open Access

Association of physical exercise and calcium intake with bone mass measured by quantitative ultrasound

Yannis Dionyssiotis[1,2*], Ioanna Paspati[1], Georgios Trovas[1], Antonios Galanos[1], Georgios P Lyritis[1]

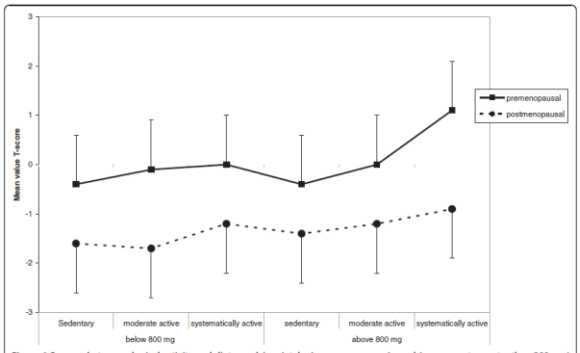


Figure 6 Synergy between physical activity and dietary calcium intake in women consuming calcium amounts greater than 800 mg/day. This graphic depicts mean QUS T-score values calculated according to daily calcium intake in all premenopausal and postmenopausal activity groups using 800 mg daily as cut off point (for statistical significant values see text).

PART III

CALCIUM, VITAMIN D, AND VITAMIN D ANALOGUES IN PREVENTION OF OSTEOPOROSIS (AND MANAGEMENT), FALLS & FRACTURES

Calcium – vitamin D – management of osteoporosis

ELSEVIER

Bone 42 (2008) 246–249

BONE

www.elsevier.com/locate/bone

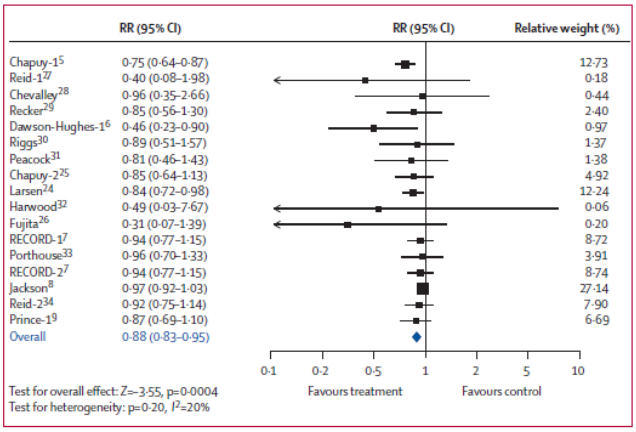
The role of calcium and vitamin D in the management of osteoporosis

R. Rizzoli[a,*], S. Boonen[b], M.L. Brandi[c], N. Burlet[d], P. Delmas[e], J.Y. Reginster[f]

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

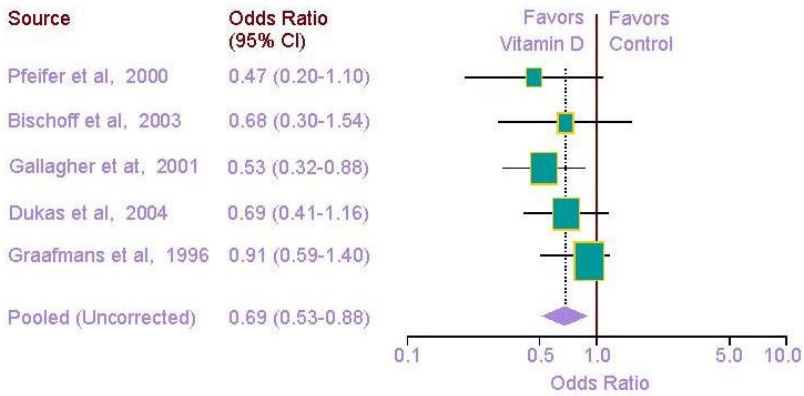
Benjamin M P Tang, Guy D Eslick, Caryl Nowson, Caroline Smith, Alan Bensoussan

Lancet 2007; 370: 657–66



Vitamin D – Falls prevention

Meta-analysis



Therapeutic Options

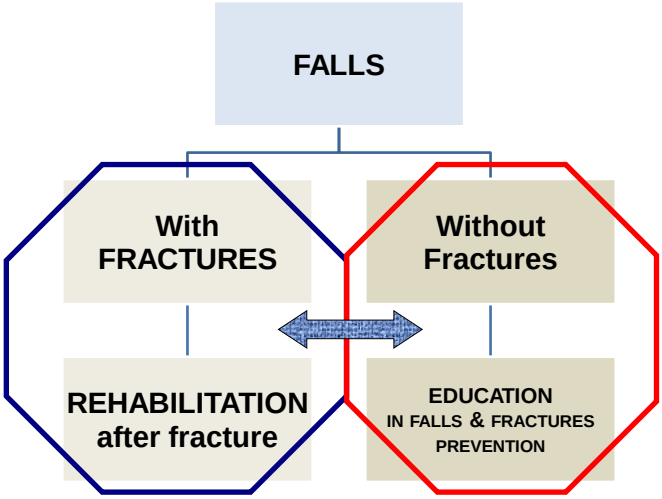
- **Antiresorptive Therapy**
  - **Calcitonin**
  - **Raloxifene**
  - **Bisphosphonates**
    - **Alendronate**
    - **Risedronate**
    - **Ibandronate**
    - **Zolendronic Acid**
  - **Denosumab**
- **Anabolic Therapy**
  - **Parathyroid hormone (1,84 PTH)**
  - **Teriparatide (1,34 PTH)**

Strontium ranelate (??)

PART IV

FALLS

The dual role of Rehabilitation



picture modified with permission from:
Dionyssiotis Y, Dontas IA, Economopoulos D, Lyritis GP Rehabilitation after falls and fractures. J Musculoskelet Neuronal Interact. 2008 Jul-Sep; 8(3):244-50.

RISK FACTORS FOR FALLING

can be classified as either:

- Intrinsic
- Extrinsic
- Exposure to risk

	Intrinsic Risk Factors	Extrinsic Risk Factors
Nonmodifiable factors	Age Gender Race Chronic disease: physical Chronic disease: psychological	
Modifiable factors	Acute illness Incontinence History of falls Gait and mobility impairment Visual/sensory deficits	Medications/side effects Home hazards Footwear

Todd C, Skelton D (2004). *What are the main risk factors for falls among older people and what are the most effective interventions to prevent these falls?* Copenhagen, WHO Regional Office for Europe (Health Evidence Network Report ;http://www.euro.who.int/document/E82552.pdf,
Guideline for the Prevention of Falls in Older Persons *American Geriatrics Society, British Geriatrics Society, and American Academy of Orthopaedic Surgeons Panel on Falls Preventionhttp://www.americangeriatrics.org*

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

I-DONT-FALL

Integrated prevention and Detection sOlutioNs Tailored to the population and risk factors associated with FALLs

Fig. 2: The *i*-Walker.

I-DONT-FALL

2.2.3 Functional View

Five main services are provided by the *i*-Walker 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 *i*-Walker status will be published to IDF present devices and remote servers.

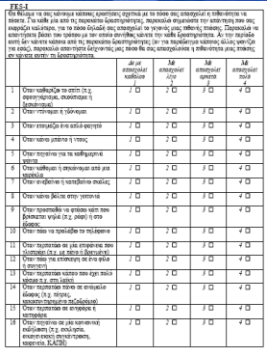
I-DONT-FALL

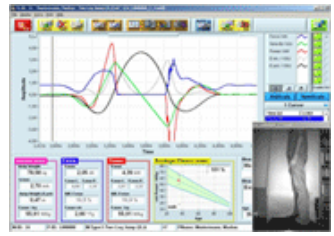
Expected outcomes

- 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

Research - Falls

•**PR**evention **O**f **FA**lls **N**etwork **E**urope **(PROFANE)**





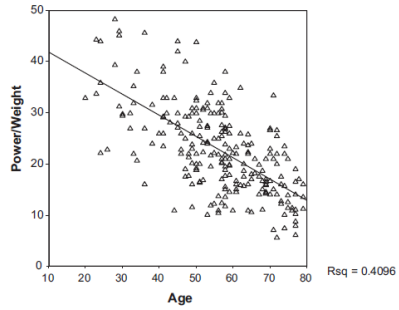


Figure 1 Age-declined power/weight parameter for Greek women ($y = 45.98–0.41x$, $R^2 = 0.41$; $p < 0.001$).

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)

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

Järvinen TL, Sievänen H, Khan KM, Heinonen A, Kannus P. BMJ. 2008 Jan 19;336(7636):124-6.

- In the elderly people the **strongest single risk factor for fracture** is falling and not osteoporosis

Kannus P, Niemi S, Parkkari J, Palvanen M, Heinonen A, Sievanen H, et al. Why is the age-standardized incidence of low-trauma fractures rising in many elderly populations? J Bone Miner Res2002;17:1363-7.
Kannus P, Sievanen H, Palvanen M, Jarvinen T, Parkkari J. Prevention of falls and consequent injuries in elderly people. Lancet2005;366:1885-93.

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

Assessment and Risk Factor	Management
Circumstances of previous falls*	Changes in environment and activity to reduce the likelihood of recurrent falls
Medication use High-risk medications (e.g., benzodiazepines, other sleeping medications, neuroleptics, antidepressants, anticonvulsants, or class IA antiarrhythmics)*†† Four or more medications†	Review and reduction of medications
Vision* Acuity <20/60 Decreased depth perception Decreased contrast sensitivity Cataracts	Ample lighting without glare; avoidance of multifocal glasses while walking; referral to an ophthalmologist
Postural blood pressure (after ≥5 min in a supine position, immediately after standing, and 2 min after standing)† ≥20 mm Hg (or ≥20%) drop in systolic pressure, with or without symptoms, either immediately or after 2 min of standing	Diagnosis and treatment of underlying cause, if possible; review and reduction of medications; modification of salt restriction; adequate hydration[46]; compensatory strategies (e.g., elevation of head of bed, rising slowly, or dorsiflexion exercises); pressure stockings; pharmacologic therapy if the above strategies fail
Balance and gait†† Patient's report or observation of unsteadiness Impairment on brief assessment (e.g., the Get-Up and Go test[25,26] or performance-oriented assessment of mobility[27])	Diagnosis and treatment of underlying cause, if possible; reduction of medications that impair balance; environmental interventions; referral to physical therapist for assistive devices and for gait and progressive balance training
Targeted neurologic examination Impaired proprioception* Impaired cognition* Decreased muscle strength††	Diagnosis and treatment of underlying cause, if possible; increase in proprioceptive input (with an assistive device or appropriate footwear that encases the foot and has a low heel and thin sole); reduction of medications that impede cognition; awareness on the part of caregivers of cognitive deficits; reduction of environmental risk factors; referral to physical therapist for gait, balance, and strength training
Targeted musculoskeletal examination: examination of legs (joints and range of motion) and examination of feet*	Diagnosis and treatment of the underlying cause, if possible; referral to physical therapist for strength, range-of-motion, and gait and balance training and for assistive devices; use of appropriate footwear; referral to podiatrist
Targeted cardiovascular examination† Syncope Arrhythmia (if there is known cardiac disease, an abnormal electrocardiogram, and syncope)	Referral to cardiologist; carotid-sinus massage (in the case of syncope)
Home-hazard evaluation after hospital discharge††	Removal of loose rugs and use of nightlights, nonslip bathmats, and stair rails; other interventions as necessary

Tinetti ME. Clinical practice. Preventing falls in elderly persons. N Engl J Med. 2003 Jan 2;348(1):42-9.

The NEW ENGLAND JOURNAL of MEDICINE

CLINICAL PRACTICE

Preventing Falls in Elderly Persons

Mary E. Tinetti, M.D.

Table 1. Strategies Shown in Randomized Clinical Trials to Be Effective in Reducing the Occurrence of Falls among Elderly Persons Living in the Community.*

Strategy	Estimated Risk Reduction	No. of Trials with Positive Results†
	%	
Health care–based strategy‡		
Balance and gait training and strengthening exercise	14–27	2 of 3
Reduction in home hazards after hospitalization	19	1 of 1
Discontinuation of psychotropic medication	39	1 of 1
Multifactorial risk assessment with targeted management§	25–39	3 of 3
Community-based strategy¶		
Specific balance or strength exercise programs	29–49	2 of 2

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.

Lee MS, Pittler MH, Shin BC, Ernst E. Tai chi for osteoporosis: a systematic review. Osteoporos Int. 2008 Feb;19(2):139-46.

[Intervention Review]

Interventions for preventing falls in older people living in the community

Lesley D Gillespie[1], M Clare Robertson[1], William J Gillespie[2], Sarah E Lamb[3], Simon Gates[3], Robert G Cumming[4], Brian H Rowe[5]

THE COCHRANE COLLABORATION®

- Included 111 studies (55.303 participants).
- Multiple-component group exercise reduces rate of falls and risk of falling. (RR 0.83, 95% CI 0.72-0.97)
- Tai Chi as a group exercise reduces rate of falls and risk of falling (RR 0.65, 95% CI 0.51-0.82).
- Individually prescribed exercise carried out at home reduces rate of falls and 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)

Gillespie LD, Robertson MC, Gillespie WJ, Lamb SE, Gates S, Cumming RG, Rowe BH. Interventions for preventing falls in older people living in the community. Cochrane Database Syst Rev. 2009 Apr 15;(2):CD007146.

Functional-Task Exercise Versus Resistance Strength Exercise to Improve Daily Function in Older Women: A Randomized, Controlled Trial

Paul L. de Vreede, BSc, Monique M. Samson, MD, PhD,* Nico L. U. van Meeteren, PT, PhD,†‡ Sijmen A. Duursma, MD, PhD,* and Harald J. J. Verhaar, MD, PhD**

J Am Geriatr Soc 53:2–10, 2005.

- 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

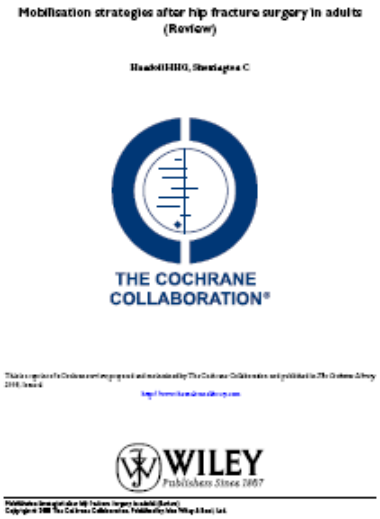
Rehabilitation after surgical stabilization of the hip fracture

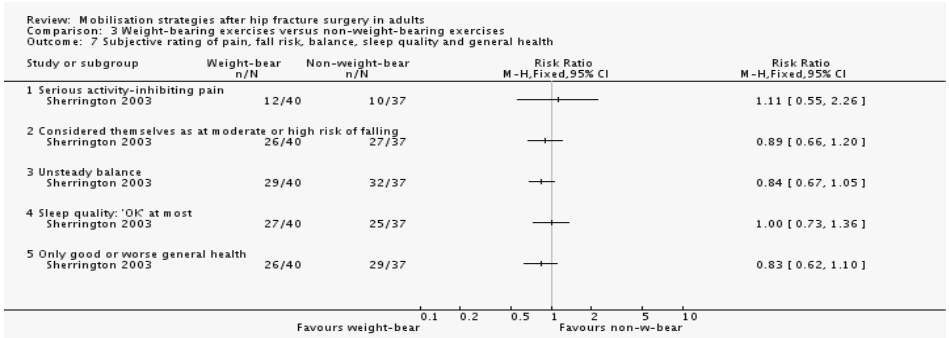
- **Operative treatment has proven necessary** to optimize post-injury mobility and **functional recovery** in the majority of hip fracture victims.[1]

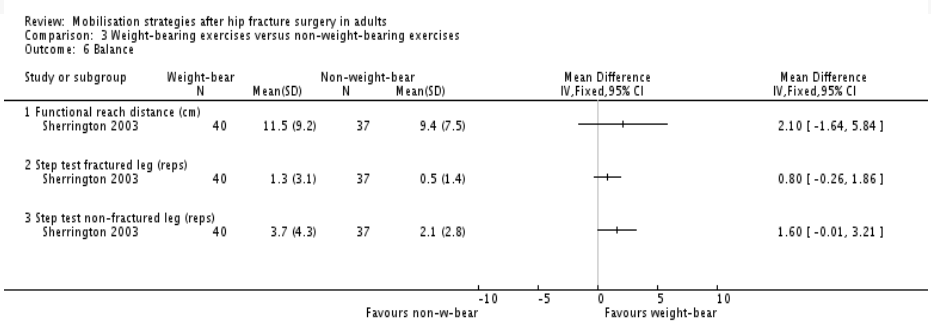
- **Rehabilitation after surgical stabilization of the hip fracture is crucial to regain prefracture function** and to avoid long-term institutionalization that can be as high as 25% 1 year postfracture.[2]

1. Koval K.J & Cooley M.R .Clinical pathway after hip fracture. Disability and Rehabilitation, 2005;27(18-19): 1053 – 1060
2. Munin MC, Seligman K, Dew MA, Quear T, Skidmore ER, Gruen G, Reynolds CF III, Lenze EJ. Effect of rehabilitation site on functional recovery after hip fracture. Arch Phys Med Rehabil 2005;86:367-72.

Handoll HHG, Sherrington C. Mobilisation strategies after hip fracture surgery in adults. *Cochrane Database of Systematic Reviews* 2007, Issue 1. Art. No.: CD001704. DOI: 10.1002/14651858. CD001704.pub3.

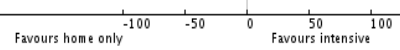


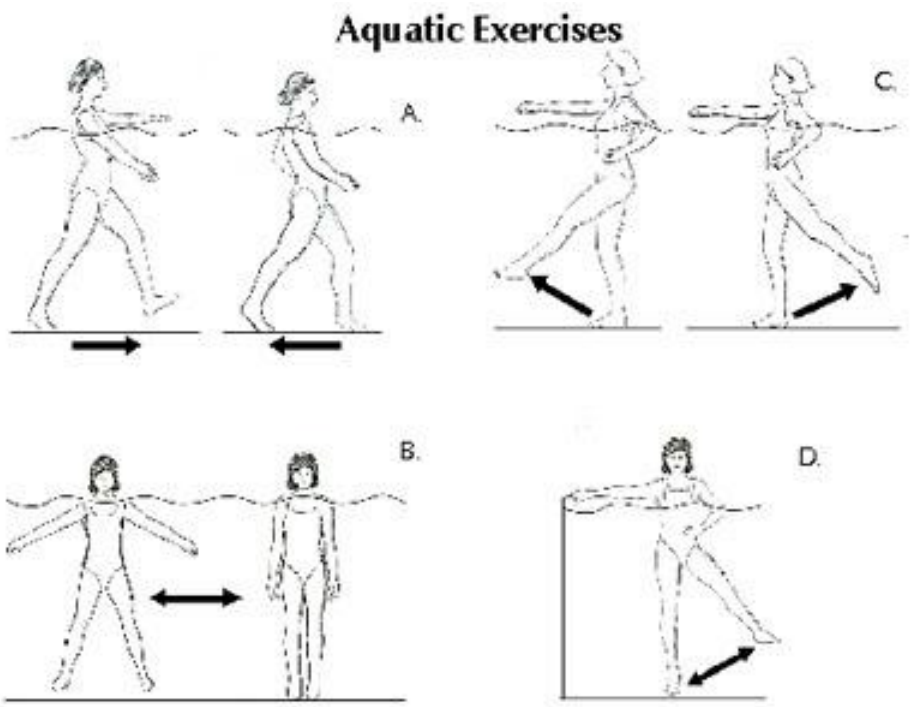




Review: Mobilisation strategies after hip fracture surgery in adults
Comparison: 9 Supervised intensive physical therapy and exercise training versus low-intensity home exercise
Outcome: 7 Quality of life at 6 months

Study or subgroup	Intensive exercise N	Intensive exercise Mean(SD)	Home exercise N	Home exercise Mean(SD)	Mean Difference IV,Fixed,95% CI	Mean Difference IV,Fixed,95% CI
1 SF-36 Physical Function subscale (0 to 100: best)						
Binder 2004	41	74 (22)	42	63 (27)		11.00 [0.42, 21.58]
2 SF-36 Social Function subscale (0 to 100: best)						
Binder 2004	41	92 (16)	42	87 (24)		5.00 [-3.76, 13.76]
3 Hip Rating Questionnaire Score (0 to 100: best)						
Binder 2004	41	84 (11)	42	80 (11)		4.00 [-0.73, 8.73]





J Musculoskelet Neuronal Interact 2008; 8(3):244-250

Review Article

Hylonome

Rehabilitation after falls and fractures

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

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

Abstract

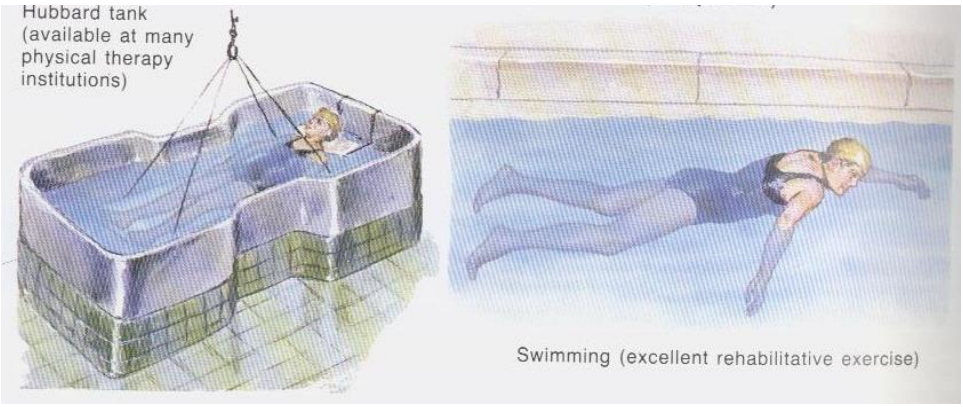
Falls are one of the most common geriatric problems threatening the independence of older persons. Elderly patients tend to fall more often and have a greater tendency to fracture their bones. Fractures occur particularly in osteoporotic people due to increased bone fragility, resulting in considerable 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

Health Professional's Guide to Rehabilitation of the Patient with Osteoporosis. 2003. 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]**

1. Patrick D. Orthotics. In: Kauffman TL, ed. *Geriatric Rehabilitation Manual.* Philadelphia, Pa: Churchill Livingston; 1999.

Spinomed ®,

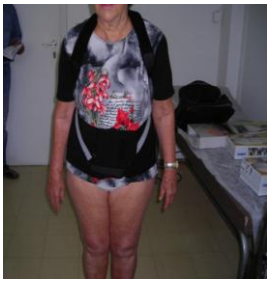
With permission from Medi Bayreuth, Germany

Pfeifer M, Begerow B, Minne HW. Effects of a new spinal orthosis on posture, trunk strength, and quality of life in women with postmenopausal osteoporosis: a randomized trial. Am J Phys Med Rehabil 2004;83:177-86.

Pfeifer M., Kohlwey L., Begerow B., Minne HW . The Orthoses Spinomed and Spinomed 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

1.Vogt L, Hübscher M, Brettmann K, Banzer W, Fink M. Postural correction by osteoporosis orthosis (Osteo-med): a randomized, placebo-controlled trial. Prosthet Orthot Int. 2008 Mar;32(1):103-10.
2.Hildebrandt HD, Vogt L (2002) Der "Osteoporosebody" - eine multifunktionale Orthese. Orthopädie-Technik 2, Februar 53. Jahrgang:90-96



BASED ON GATE CONTROL THEORY

Effects of a New Spinal Orthosis on Posture, Trunk Strength, and Quality of Life in Women with Postmenopausal Osteoporosis

Pfeifer M, Begerow B, Minne HW: Effects of a new spinal orthosis on posture, trunk strength, and quality of life in women with postmenopausal osteoporosis: A randomized trial. *Am J Phys Med Rehabil* 2004;83:177–186.

L. Vogt[1]
H.-D. Hildebrandt[2]
K. Brettmann[1]
M. Fischer[3]
W. Banzer[1]

Clinical Multidimensional Evaluation of a Multifunctional Osteoporosis-Orthosis

Klinische mehrdimensionale Evaluation einer multifunktionalen Osteoporoseorthose

Phys Med Rehab Kuror 2006; 16: 1–8 © Georg Thieme Verlag KG Stuttgart · New York
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Prosthetics and Orthotics International
March 2008; 32(1): 103–110

informa
healthcare

Postural correction by osteoporosis orthosis (Osteo-med): A randomized, placebo-controlled trial

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(a) (b) (c) (d)

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MINI-REVIEW

Management of osteoporotic vertebral fractures

Yannis Dionyssiotis

Rhodes General Hospital,
Rhodes, Greece

Abstract: Osteoporotic vertebral fractures are associated with considerable reduction of quality of life, morbidity, and mortality. The management of patients with vertebral fractures should include treatment for osteoporosis and measures to reduce pain and improve mobility. This article provides information for management and rehabilitation of vertebral fractures based on clinical experience and literature.

Keywords: vertebral fracture, quality of life, rehabilitation, osteoporosis

Table 1 Differences in values of visual analog scale (VAS) and personal isometric force: force (F)/weight (W) in abdominals and extensors muscles (F/W abdominals and F/W extensors, respectively), after 6 months wearing Spinomed orthosis. (F: force in Newton, W: weight in Kg) measured with ISO-RACK device (Digimax, MechaTronic, Germany)

Patients in the beginning of the study (1) vs patients wearing Spinomed for 6 months (2)			
Variables	**Patients starting wearing Spinomed n = 10 mean ± sd**	**Patients wearing Spinomed for 6 months n = 10 mean ± sd**	***P*-value**
VAS (difference VAS 1 – VAS 2)	65 ± 16.5	41 ± 17	0.001
F/W abdominals (difference F/Wabd 1 – F/Wabd 2) (N)	131.1 ± 53.7	197.8 ± 82.7	0.005
F/W extensors (difference F/W ext 1 – F/W ext 2) (N)	197.6 ± 48	246.3 ± 59.5	0.003

Spinal orthoses - pain

J Rehabil Med 2007; 39: 77–80

ORIGINAL REPORT

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

Matthias Fink[1], Banu Kalpakcioglu[2], Matthias Karst[3] and Michael Bernateck[3]

From the Departments of [1]Physical Medicine and Rehabilitation and [3]Anaesthesiology and Pain Medicine, Hannover Medical School, Hannover, Germany and [2]Haseki 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.

Leidig G, Minne HW, Sauer P, Wuster C, Wuster J, Lojen M, et al. Study of complaints and their relation to vertebral destruction in patients with osteoporosis. Bone Miner 1990; 8: 217–229.

the problem of compliance

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

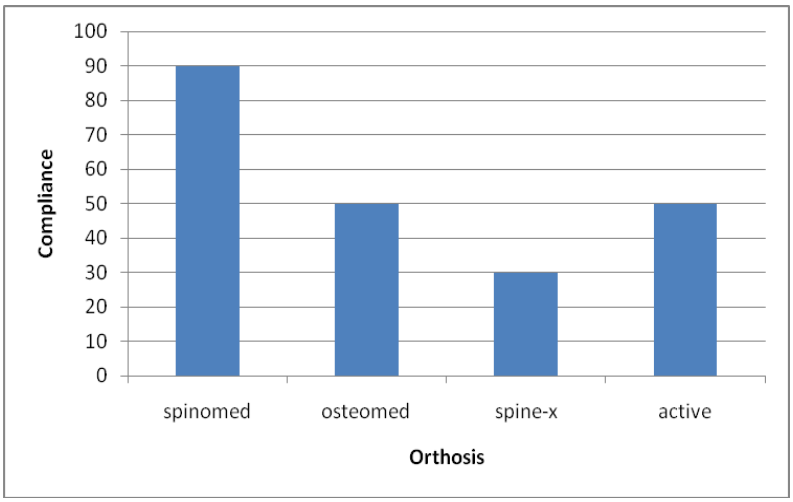
Reference	Medication	Number	Mean MPR	Time period
[7]	Raloxifene	1,514	0.61	1 year
	Bisphosphonates	3,720	0.68	
	HRT	46,109	0.73	
	2 HRTs	6,766	0.81	
[19]	Combined alendronate, risedronate, HRT	38,120	0.66	Average follow-up 1.7 years
[8]	Combined alendronate, risedronate, etidronate, etidronate/calcium, calcitonin salmon nasal spray, conjugated estrogen, estradiol valerate, or ethinyl estradiol	11,249	0.70	Average follow-up 2 years
[9]	Alendronate, etidronate, calcitonin, or HRT	91	0.70	Mean of 590 days (participants)
		85	0.67	Mean of 518 days (refusers)
[25]	Alendronate, risedronate	2,741	0.61	1 year
[26]				
GPRD	Alendronate, risedronate	7,567	0.74	1 year
MEDIPLUS		5,962	0.68	
DIN		1,801	0.59	
[27][a]				
THALES	Alendronate, risedronate	5,332	0.58	1 year

HRT: hormone replacement therapy; GPRD: General Practice Research Database; MEDIPLUS: IMS Disease Analyzer; DIN: Doctors Independent Network database.
[a] Included data from the studies in Cramer et al. [25] and Brankin et al. [26] (already presented separately).

Cramer JA, Gold DT, Silverman SL, Lewiecki EM. A systematic review of persistence and compliance with bisphosphonates for osteoporosis. Osteoporos Int. 2007 Aug;18(8):1023-31.

Compliance

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

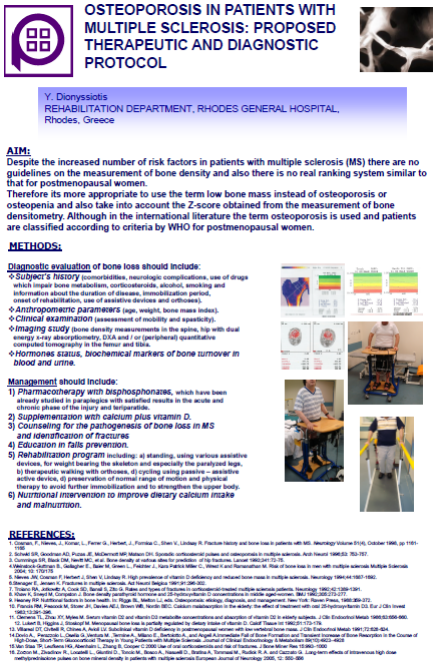


Hip protectors

Parker MJ, Gillespie WJ, Gillespie LD. Hip protectors for preventing hip fractures in older people. Cochrane Database Syst Rev. 2005 Jul 20
HUANG H-C, LEE C-H & WU S-L .Hip protectors: a pilot study of older people in Taiwan . Journal of Clinical Nursing 15, 436–443 (2006)

PART VI

WHAT ABOUT DISABLED POPULATIONS



OSTEOPOROSIS IN PATIENTS WITH MULTIPLE SCLEROSIS: PROPOSED THERAPEUTIC AND DIAGNOSTIC PROTOCOL

Y. Dionyssiotis
REHABILITATION DEPARTMENT, RHODES GENERAL HOSPITAL, Rhodes, Greece

AIM:
Despite the increased number of risk factors in patients with multiple sclerosis (MS) there are no guidelines on the measurement of bone density and also there is no real ranking system similar to that for postmenopausal women.
Therefore its more appropriate to use the term low bone mass instead of osteoporosis or osteopenia and also take into account the Z-score obtained from the measurement of bone densitometry. Although in the international literature the term osteoporosis is used and patients are classified according to criteria by WHO for postmenopausal women.

METHODS:

Diagnostic evaluation of bone loss should include:
- *Subject's history* (comorbidities, neurologic complications, use of drugs which impair bone metabolism, corticosteroids, alcohol, smoking and information about the duration of disease, immobilization period, onset of rehabilitation, use of assistive devices and orthoses).
- *Anthropometric parameters* (age, weight, bone mass index).
- *Clinical examination* (assessment of mobility and spasticity).
- *Imaging study* (bone density measurements in the spine, hip with dual energy x-ray absorptiometry, DXA and / or (peripheral) quantitative computed tomography in the femur and tibia.
- *Hormones status, biochemical markers of bone turnover in blood and urine.*

Management should include:
1) *Pharmacotherapy with bisphosphonates*, which have been already studied in paraplegics with satisfied results in the acute and chronic phase of the injury and teriparatide.
2) *Supplementation with calcium plus vitamin D.*
3) *Counseling for the pathogenesis of bone loss in MS and identification of fractures*
4) *Education in falls prevention.*
5) *Rehabilitation program* including: a) standing, using various assistive devices, for weight bearing the skeleton and especially the paralyzed legs, b) therapeutic walking with orthoses, d) cycling using passive – assistive active device, d) preservation of normal range of motion and physical therapy to avoid further immobilization and to strengthen the upper body.
6) *Nutritional intervention to improve dietary calcium intake and malnutrition.*

REFERENCES:

BONE LOSS IN PARAPLEGIA
A DIAGNOSTIC AND THERAPEUTIC PROTOCOL

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

OBJECTIVE

To propose a diagnostic and therapeutic protocol for the evaluation and management of bone loss in chronic paraplegia.

MATERIAL and METHODS

Despite the fact of increased bone loss in paraplegics there are no guidelines concerning bone density measurements and classification for osteoporosis – osteopenia similar with postmenopausal women. In the literature paraplegics are classified according to WHO criteria for osteoporosis in postmenopausal women. The term low bone mass instead of osteoporosis should be used to characterise this specific population.

RESULTS

Diagnostic evaluation of bone loss should include:
- *Subject's history* (co morbidities, neurologic complications, use of drugs which impair bone metabolism, alcohol, smoking and information about the level of injury, duration of paralysis, immobilization period, onset of rehabilitation, use of assistive devices and orthoses)
- *Anthropometric parameters* (age, weight, bone mass index).
- *Clinical examination* (assessment of the neurological level of injury and spasticity).
- *Imaging study* (bone density measurements in the hip with dual energy x-ray absorptiometry, DXA and / or (peripheral) quantitative computed tomography in the femur and tibia.
- *Hormones status, biochemical markers of bone turnover in blood and urine.*

Management should include:
1) *Pharmacotherapy with biphosphonates*, which have been already studied in paraplegics with satisfied results in the acute and chronic phase of the injury.
2) *Supplementation with calcium plus vitamin D.*
3) *Counseling for the pathogenesis of bone loss in paraplegia, and identification of fractures in regions without sensation.*
4) *Education in falls prevention.*
5) *Rehabilitation program* including: a) standing, using various assistive devices, for weight bearing the skeleton and especially the paralyzed legs, b) therapeutic walking with orthoses, d) cycling using passive – assistive active device, d) preservation of normal range of motion and physical therapy to avoid further immobilization and to strengthen the upper body.
6) *Nutritional intervention to improve dietary calcium intake and malnutrition.*

CONCLUSION
In this super fast bone loser population we should shift the focus from low bone mass to fracture prevention.

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Bone loss in paraplegia. a diagnostic and therapeutic protocol. 9th European Congress on Clinical and Economic Aspects of Osteoporosis and Osteoarthritis - ECCEO 9 - Athens. Greece.
Osteoporos Int (2009) 20 (Suppl 1):S23–S176

International Journal of General Medicine

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REVIEW

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

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International Journal of General Medicine
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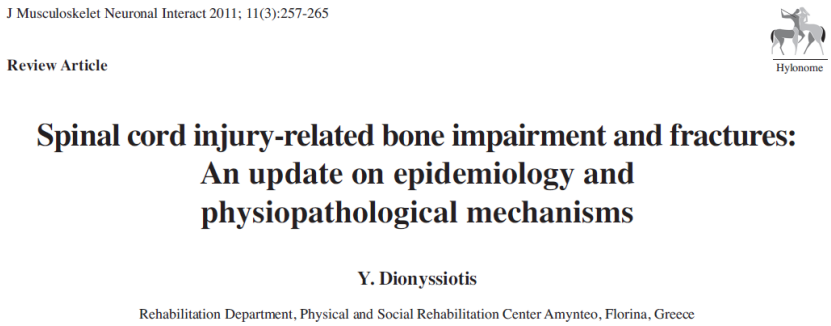
Yannis Dionyssiotis
Rehabilitation Department, Physical and Social Rehabilitation Center, Amyntaio, Florina, Greece

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



J Musculoskelet Neuronal Interact 2011; 11(3):257-265

Review Article

Hylonome

Spinal cord injury-related bone impairment and fractures: An update on epidemiology and physiopathological mechanisms

Y. Dionyssiotis

Rehabilitation Department, Physical and Social Rehabilitation Center Amynteo, Florina, Greece

East gate of the Medieval City of Rhodes

Knights' street (Old Town Rhodes)
6:00 in the morning

Temple of Poseidon, Sounion, Athens

thank you for your participation