

Good vibrations: or are they?

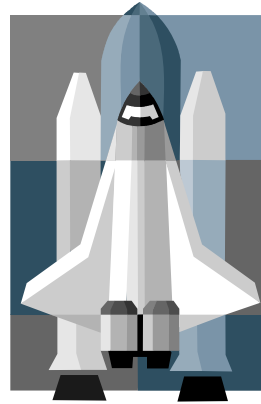
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Disclosures: none

What is vibration?

Mechanical stimulus using
high magnitude high frequency/
low magnitude high frequency
to induces changes in muscle strength and
dimensions of the bone (strain)



Load
(muscle)

Mechanostat

Hormones
(eg estrogens)
Cytokines
Calcium
Vitamins
Growth factors

Bone stiffness



Material
quality



Architecture

Remodelling

800 μ strains

Postural strains
< 100 μ strains

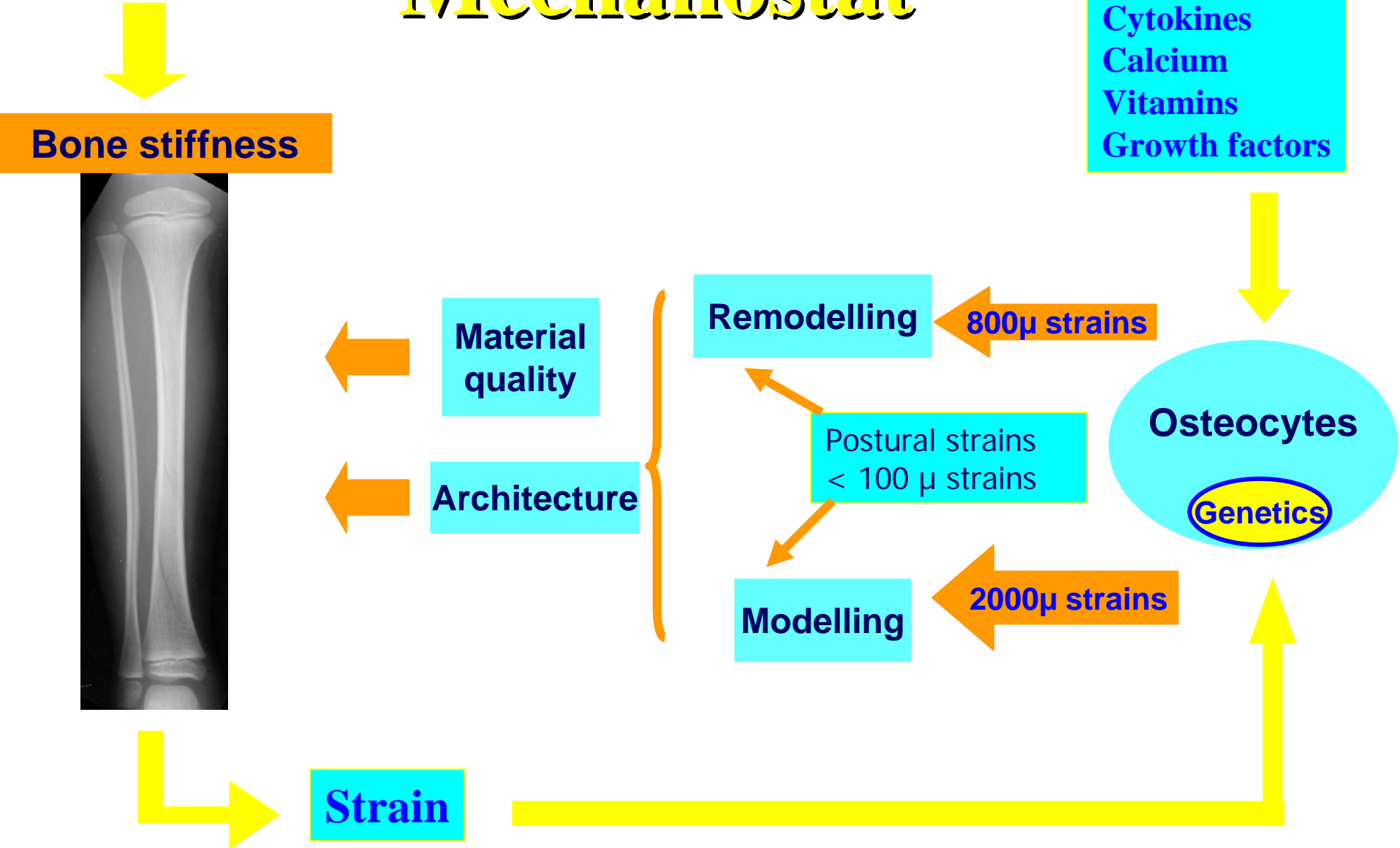
Modelling

2000 μ strains

Osteocytes

Genetics

Strain





FREE BROCHURE
click here 

- Multitude of devices (n ~ 10)
- £288 (\$576) - £6995 (\$13,990)
- Vertical vs alternate vs multiplanar
- Peak vs postural strains



Marketing X

- Treatment of osteoporosis
 - Increase bone density
 - Prevention of bone loss
- Low impact exercise:
independent of age / fitness
- Shortens workout time
- Reduces cellulite
- Total body wellness

Marketing Y

- Better posture helping reduce from pain/injuries due to weak core muscles.
- Increases circulation to increase blood flow and assist in tissue repair, flush out toxins and improve the appearance of the skin.
- Increased flexibility
- Increased bone mineral density
- Reduction of the stress hormone cortisol
- Elevation of Human Growth Hormone
- Improved lymphatic flow
- Massage

Marketing Z

- **The bone building alternative to osteoporosis therapies**
- **Prevent bone loss and improve bone density and strength**
- **Restore the dynamic action of Type IIA (lower leg) muscle fibers**
- **Stimulate blood and lymphatic flow from the lower limbs**
- **Prevents and reverses the loss of bone due to osteoporosis**
- **Reduces the possibility of spinal or hip fractures**
- **Excellent option for those unable or unwilling to take osteoporosis medication**
- **Noninvasive and less costly than chronic drug therapy**
- **Gentle in its repetitive vertical movement**
- **Convenient with only a required daily treatment of 20 minutes**
- **Simple, mobile and safe to use in the privacy of your own home**

Who will benefit?



Indications

- Osteoporosis
- General weakness & lack of training
- All kinds of muscular deficiencies
- Tense backs
- Unspecific back pain
- Imbalances
- Falls in elderly
- Blood circulation
- Spina bifida/ brittle bone disease
- Incontinence

Contraindications

- pregnancy
- recent or possible thrombosis
- cardiovascular complaints, e.g. valve disorder
- advanced arthrosis, arthropathy, acute RA
- Advanced osteoporosis
- recent surgery/ scars
- foot, knee and hip implants
- any metal/synthetic implants, e.g. pacemaker
- lumbar disc problems
- acute inflammations or infections
- migraine headaches
- Epilepsy
- Gall & kidney stones
- Retinal problems

High magnitude, high frequency

Post menopausal women/ elderly

- Muscle function
 - power
 - isometric strength
 - balance
- WBV had greater effects than an exercise intervention in the elderly
- Bone effects are conflicting
 - increased BMD or reduction in bone loss at the femoral neck
 - no change in tibia BMD or bone geometry
- Bisphosphonates + WBV reduced chronic back pain in WBV group; change in lumbar spine BMD was similar between groups

(WBV = whole body vibrations)

High magnitude, high frequency

N = 70 (58 – 74 yrs)

• RCT – 3 groups

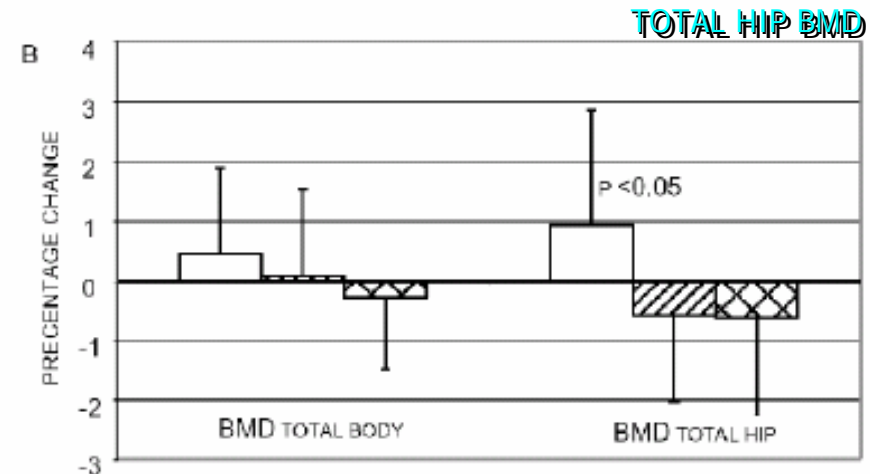
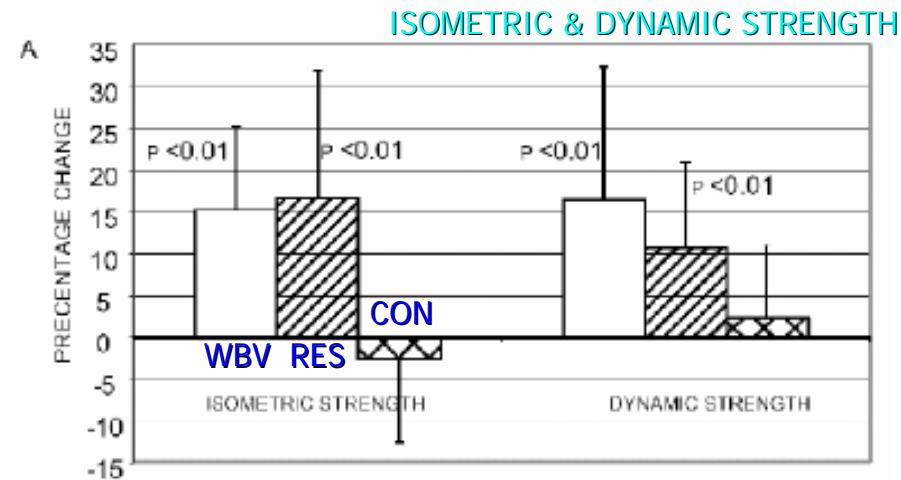
- Controls
- Resistance
- WBV

3 x week, 24 wks

• 2nd study n = 71 (60-81 yrs)

• WBV vs control

- Isometric strength +13.7% ,
 $p < 0.0001$ vs no change
- Hip BMD – no overall benefit



High magnitude, high frequency

Gusi et al . BMC Musculoskelet Disord 7, 92 (2006).

Table 2: Comparative effects of vibratory (N = 14) and walking-based exercise (N = 14) programs in postmenopausal women.

		Baseline	Change to 8 months	Treatment effect	P†
		Mean (SD)	Mean (95%CI)	Mean (95%CI)	
BMD (gr·m ⁻²)					
Lumbar spine	Vibratory	0.95 (0.12)	-0.01 (-0.04 to 0.02)	0.00 (-0.03 to 0.03)	.983
	Walking	0.83 (0.13)	-0.01 (-0.02 to 0.01)		
Femoral neck	Vibratory	0.79 (0.10)	0.02 (-0.01 to 0.04)	0.03 (0.01 to 0.06)	.011
	Walking	0.78 (0.13)	-0.02 (-0.03 to 0.00)		
Trochanter	Vibratory	0.68 (0.08)	0.01 (-0.01 to 0.02)	0.02 (-0.01 to 0.04)	.084
	Walking	0.60 (0.10)	-0.01 (-0.02 to 0.02)		
Ward's triangle	Vibratory	0.63 (0.11)	0.04 (-0.01 to 0.09)	0.03 (-0.02 to 0.09)	.070
	Walking	0.58 (0.12)	0.01 (-0.02 to 0.02)		
Balance (trials)	Vibratory	9.4 (5.1)	-2.7 (-5.7 to -0.1)	-3.2 (-6.3 to -0.2)	.023

Russo et al . Arch Phys Med Rehabil 84, 1854-7 (2003)

Table 2: Effect of 6 Months of High-Frequency Vibration Training on Muscle and Bone Parameters

	Control Group (mean ± SE)		Vibration Group (mean ± SE)		P*
	Baseline	After 6 Months	Baseline	After 6 Months	
Starting participants (n)	16	15	17	14	
Dropouts (n)	0	1	0	3	
Muscle parameters*					
Force (N)	146.3±5.9	150.1±7.0	156.6±8.5	156.8±6.6	.60
Velocity (m/s)	178.1±4.8	175.5±4.1	163.7±6.2	171.7±5.3	<.005
Power (W)	179.9±7.5	179.1±7.8	178.9±9.6	187.3±9.5	<.02
Bone parameters†					
Trabecular volumetric bone density (mg/cm ³)	186.7±6.5	185.4±6.3	190.2±10.6	186.7±11.0	.70
Cortical volumetric bone density (mg/cm ³)	1100.9±8.6	1093.6±9.6	1101.7±9.3	1099.8±9.7	.09
Cortical bone area (mm ²)	239.9±8.2	240.7±8.3	246.4±11.2	242.5±11.6	.31

High magnitude, high frequency Children

- Cologne standing and walking trainer



Pat. Number	Individual improvements
1	Sitting, now OP for limb deformities required
2	Walking with posterior walker
3	Standing with assistance
4	Knee and ankle orthesis not longer needed
5	Verticalisation up to 90 degrees on Cologne-Standing-and-Walking-Trainer System Galileo
6	Less help needed in wheelchair (obesity)
7	Independent getting in and out of his wheelchair, walking distance 30 → 250 steps with posterior walker
8	Walking distance 3 m → 18 m with walker

Low magnitude, high frequency



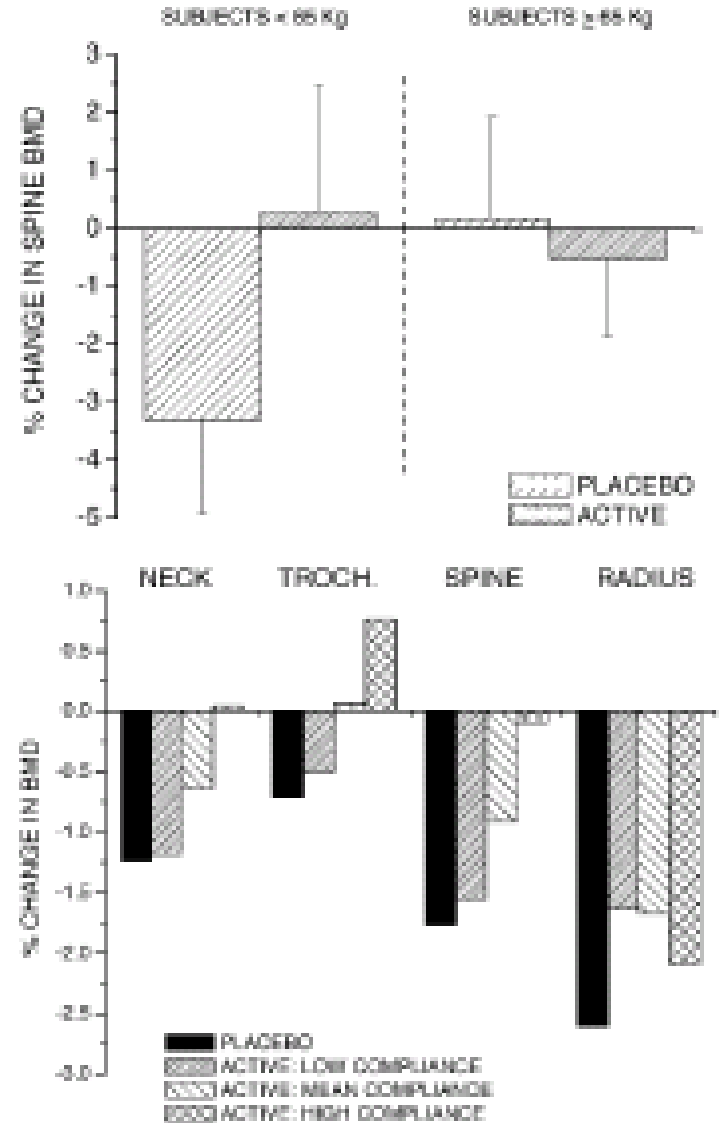
• *Lanyon et al 'In Vivo Strain Measurements from Bone and Prostheses Following Total Hip Replacement. An Experimental Study in Sheep' J B J S Am 1981;63:989-1001*

• *Rubin et al 'Anabolism: Low Mechanical Signals Strengthen Long Bones' Nature 2001;412:603-604*

Low magnitude, high frequency

Adults

- 70 post menopausal women
- 2 x 10 mins/day, 12 mo
- Reduction in bone loss
 - Fem neck $p = 0.06$
 - Spine $p = 0.09$
- Low body mass (<65kg)
 - Spine
 - $p = 0.009$ – (>36% comp)
 - $P = 0.02$ – (76 – 35% comp)



Low magnitude, high frequency

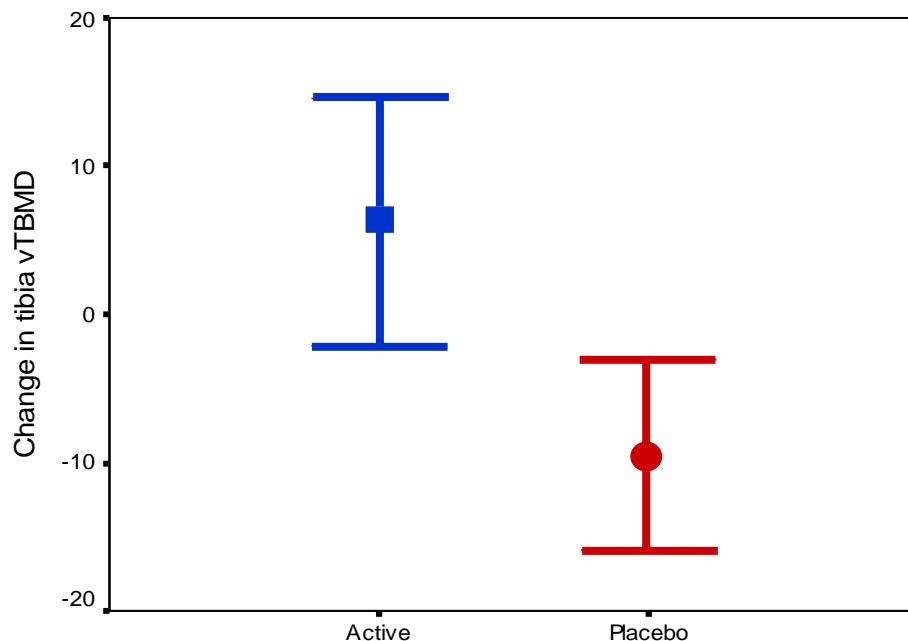
Children

Subjects

- n = 20 (14M:6F)
- aged 4-19 yrs (mean 9.1 ± 4.3 yrs)
- heterogeneous group

Vibration – 0.3G, 90Hz

10 mins/day, 5 days/wk 6 mo



Tibia ($p=0.0036$)

Active

+6.27 mg/ml(6.3%)

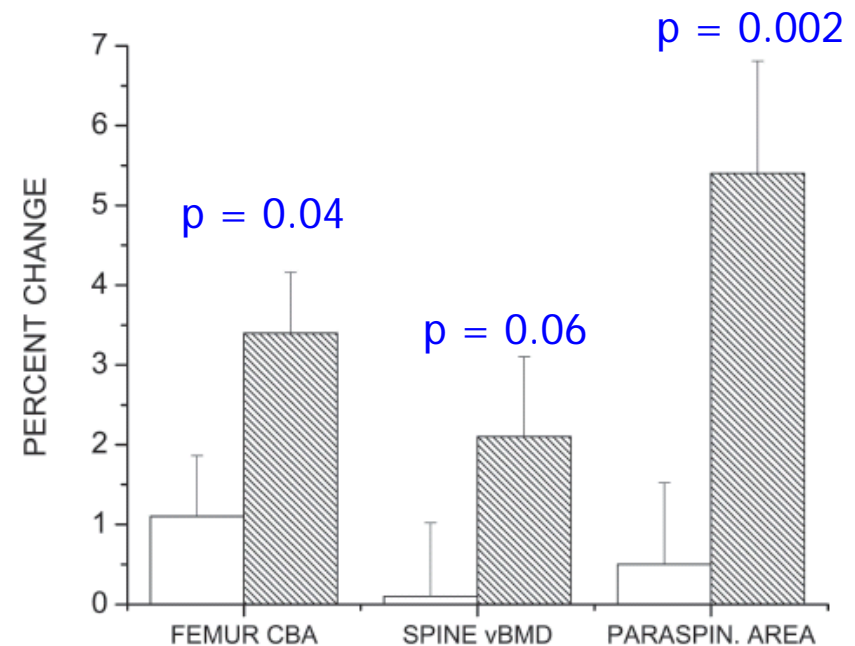
Placebo

- 9.45 mg/ml(-11.9%)

Low magnitude, high frequency

Adolescents & young adults

- Females 15-20 years, low BMD & previous Fx (n = 48)
- 10 mins/ day, 12 mo
- Compliance effect
 - Femur p = 0.009
 - Spine p = 0.001



What is required?

- More adequately powered trials
- Application alter depending upon population studied
- What is main aim
 - Reduce falls
 - Increase BMD
 - Alter bone geometry

Conclusions

- Potential non-pharmacological treatment for osteoporosis and skeletal fragility
- Number of devices available – correct use essential
- Caution with recommendations for individual use – professional advice essential
- Need to substantiate small evidence base

Good vibrations or are they??



Reviews:

- *Eisman 'Good, good, good...good vibrations: the best option for better bones' Lancet;2001:vol 358*
- *Olof & Eisman 'Whole Lotta Shakin' Goin' On' JBMR 2004;19:1205-1207*