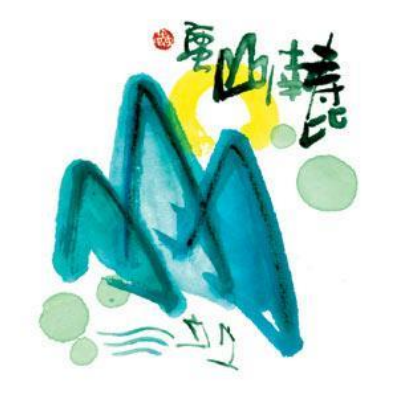
Musculoskeletal Problems Among Geriatric Patients

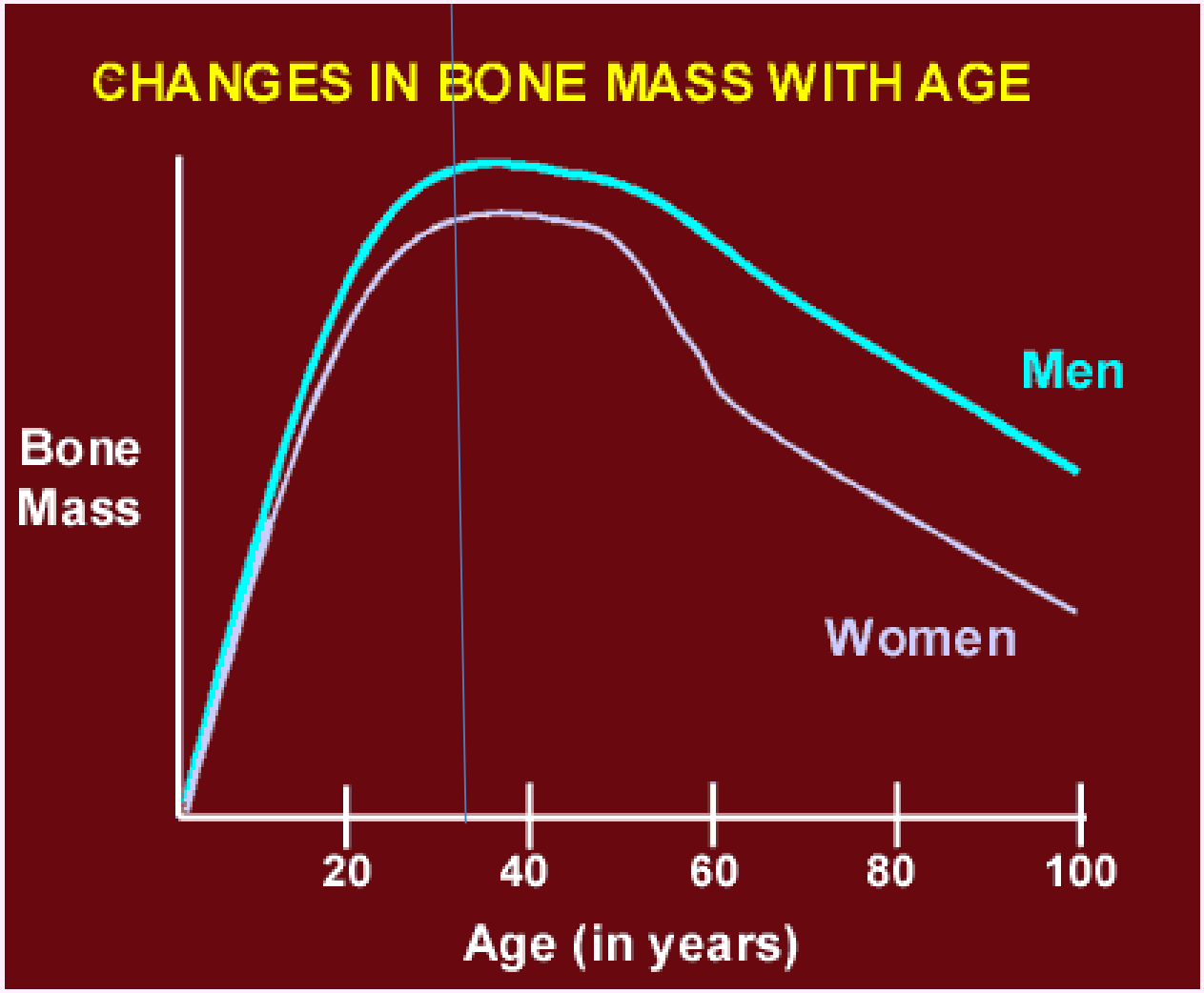
Professor Hung Leung-kim
Chairman, Department of Orthopaedics & Traumatology
The Chinese University of Hong Kong

- We are living longer
- Life expectancy of China, Taiwan, Hong Kong, Macau, Japan… well above 80
- We wish to live our life to the full
- That is 60 + 20/25



Aging Musculoskeletal

- Muscle
  - Sarcopenia
- Bone
  - Osteoporosis
- Joint
  - Osteoarthritis
- Neurological control
- Falls & Fracture



Peaking of bone mass at 27 – 35 years of age

- Prevention is important, and we should start training or building up our bodies from young age.

Exercise for the aged

- Improve balance
- Reduce risk of osteoporosis
- Cardiopulmonary well being
- Psychosocial enhancement
- ? Cognitive / dementia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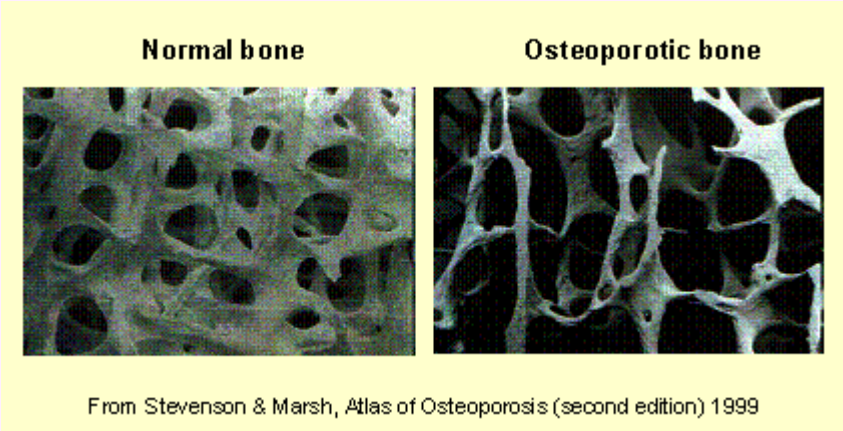
Osteoporosis

- Effect on the back
  - Postural effects – Exercise, Exercise, Exercise
- Compression fracture
- Pain



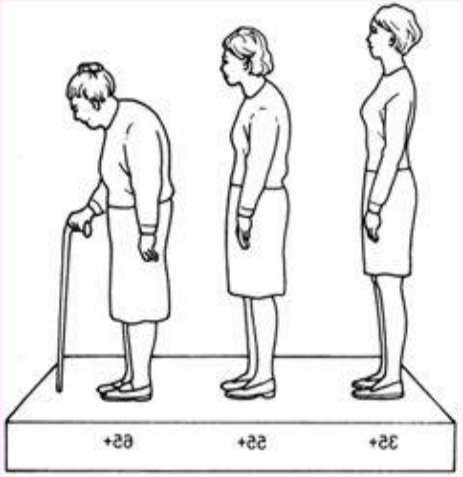


Figure 6-3. The Progression of Osteoporosis

Note: Three women demonstrate increasingly severe bowing of the spine (kyphosis) due to osteoporotic fractures of the spine.

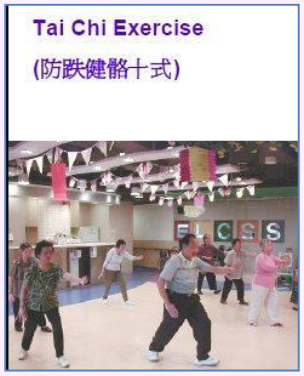
Source: Higgs and AAOS 2001.

Osteoporosis

- Diet – calcium, vit D
- Physical activities, exercise, weight training
  - Balance (Fall risk reduction)
- Medications
  - Oestrogen, Selective estrogen receptor modulators (SERM), Calcitonin, Bisphospbonates, Strontium, Teriparatide etc
- Biophysical
  - Vibration

Tai Chi 1

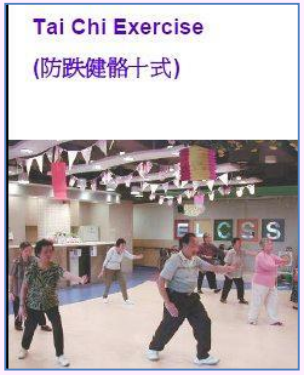
- Women within 10 years of menopause, mean age 55.9 +/- 3.1 years
- 48 regularly doing Tai Chi, >3h/week
- 51 age-matched controls, BMD and neuromuscular control



Beneficial effects of regular Tai Chi exercise on musculoskeletal system. Qin L, Chan KM et al J Bone Miner Metab 2005;23:186-190.

Tai Chi 2

- BMD average 7% more, in spine etc (P<0.05)
- 43% better quadriceps strength (p<0.01)
- 68% longer single leg stance (p<0.05)



Beneficial effects of regular Tai Chi exercise on musculoskeletal system. Qin L, Chan KM et al J Bone Miner Metab 2005;23:186-190.

Vibration – high frequency

- Improve balance
- Reduce risk of osteoporosis & complications
- ?Improve muscle metabolism (reduced insulin dependency)

Professor KS Leung & Professor Louis Cheung

NATURE | VOL 412 | 9 AUGUST 2001 | www.nature.com

brief communications

Anabolism

Low mechanical signals strengthen long bones

Although the skeleton's adaptability to load-bearing has been recognized for over a century[1], the specific mechanical components responsible for strengthening it have not been identified. Here we show that after mechanically stimulating the hindlimbs of adult sheep on a daily basis for a year with 20-minute bursts of very-low-magnitude, high-frequency vibration, the density of the spongy (trabecular) bone in the proximal femur is significantly increased (by 34.2%) compared to controls. As the strain levels generated by this treatment are three orders of magnitude below those that damage bone tissue, this

Clinton Rubin*, A. Simon Turner†, Steven Bain‡, Craig Mallinckrodt†, Kenneth McLeod*

Musculo-Skeletal Research Laboratory, Department of Biomedical Engineering, State University of New York, Stony Brook,

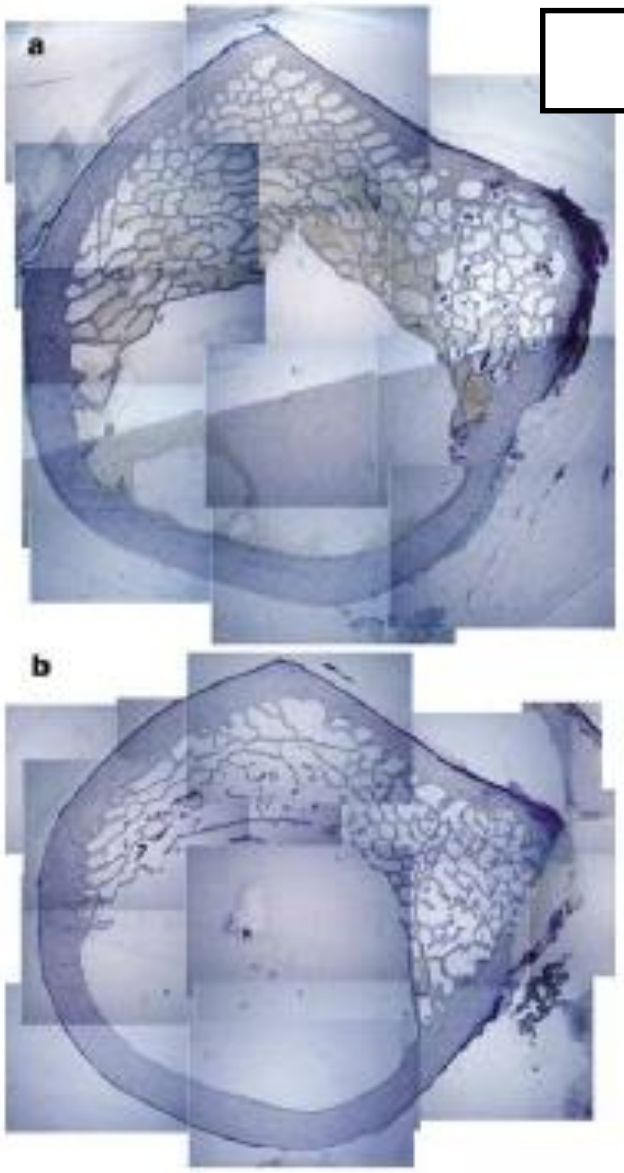
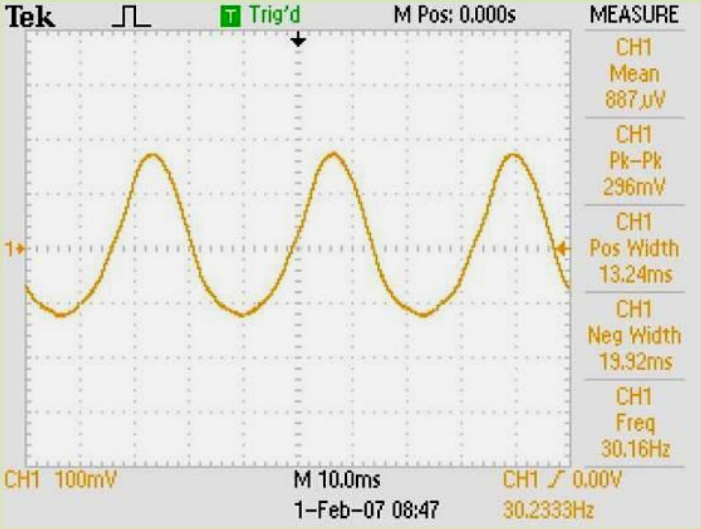


Figure 1 Montages of photomicrographs of the proximal sheep femur used for static histomorphometric evaluation after 1 year of exposure (20 min per day) to a 0.3*g*, 30-Hz mechanical stimulus. **a, b,** There is 32% more trabecular bone in the proximal femur of experimental animals (**a**) compared with age-matched controls (**b**) ($P < 0.04$).

Vibration Platform

- **Systemic vibration signals at a frequency to provide whole-body mechanical stimulation**
- Specifications:
  - Frequency: 35Hz
  - Vibration mode: vertical
  - Amplitude: <0.3g OR 0.1mm




震動治療

First Application on Fracture Healing

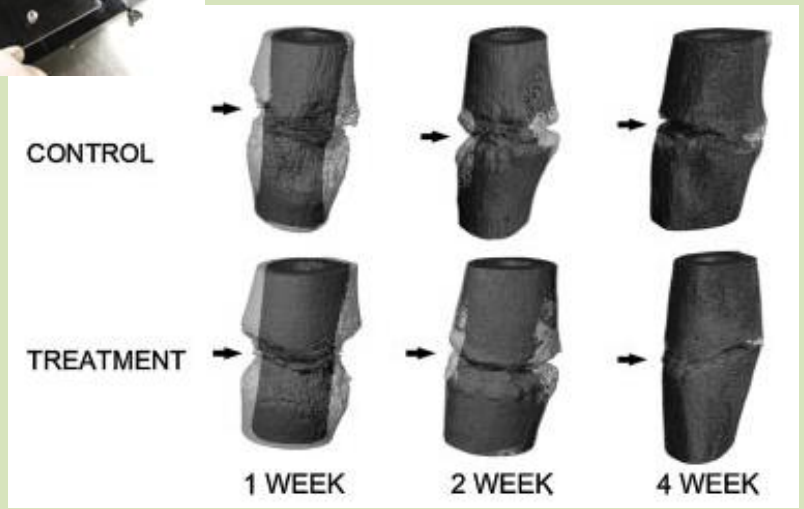
Low-Magnitude High-Frequency Vibration Accelerates Callus Formation, Mineralization, and Fracture Healing in Rats

Kwok Sui Leung, Hong Fei Shi, Wing Hoi Cheung, Ling Qin, Wai Kin Ng, Kam Fai Tam, Ning Tang

Department of Orthopaedics and Traumatology, 5/F, Clinical Science Building, Prince of Wales Hospital, The Chinese University of Hong Kong, Shatin, New Territories, Hong Kong SAR, People's Republic of China

J Orthop Res. 27(4):458-65, 2009.

- Prove anabolic effect
- Adult SD rats
- Accelerate closed fracture healing by 30% in rats
- Enhanced callus formation and mineralization



Effect of Vibration on Osteoporotic Fracture Healing

Low-magnitude high-frequency vibration treatment augments fracture healing in ovariectomy-induced osteoporotic bone

Hong-Fei Shi, Wing-Hoi Cheung, Ling Qin, Andraay Hon-Chi Leung, Kwok-Sui Leung *

Department of Orthopaedics and Traumatology, The Chinese University of Hong Kong, Shatin, Hong Kong SAR, China

Bone. 46(5):1299-305, 2010.

- Increased callus width and area, improved bridging rate, increased mechanical properties
- Osteoporotic bone is more sensitive to vibration than age-matched normal bone

Table 1
Comparison of callus bridging rate of femoral fracture healing at different time points (weeks 4, 6 and 8 post-treatment).

	Sham-C	Sham-V	OVX-C	OVX-V
Week 4	1/14 (7.1%)	4/14 (28.6%)	0/14 (0%)	2/14 (14.3%)
Week 6	3/14 (21.4%)	7/14 (50%)	5/14 (35.7%)	8/14 (57.1%)
Week 8	9/14 (64.3%)	10/14 (71.4%)	10/14 (71.4%)	14/14 (100%)

Note. Sham-C, sham-operated with no intervention; Sham-V, sham-operated with vibration treatment; OVX-C, ovariectomized with no intervention; OVX-V, ovariectomized with vibration treatment.

Table 3
Femoral mechanical properties compared at the end of 8 weeks treatment (data in mean ± SD).

	Grouping			
	Sham-C	Sham-V	OVX-C	OVX-V
Ultimate load (N)	108.8 ± 17.1	119.9 ± 17.3	90.1 ± 16.9	110.9 ± 14.4
Stiffness (N/mm)	213.9 ± 12.5	221.4 ± 14.4	198.7 ± 17.4	218.3 ± 15.6
Energy to failure (N mm)	50.7 ± 16.3	59.8 ± 12.9	33.9 ± 19.4[a]	57.6 ± 19.2[a]

Note. Sham-C, sham-operated with no intervention; Sham-V, sham-operated with vibration treatment; OVX-C, ovariectomized with no intervention; OVX-V, ovariectomized with vibration treatment.

[a] $p = 0.05$ between OVX-V and OVX-C.

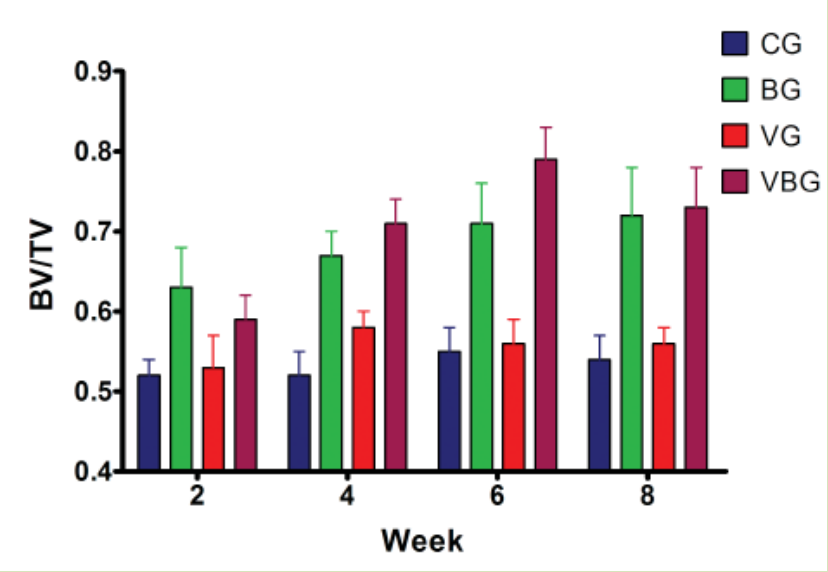
Vibration Enhances Bone Remodeling in Fracture Healing

Low-Magnitude High-Frequency Vibration (LMHFV) Enhances Bone Remodeling in Osteoporotic Rat Femoral Fracture Healing

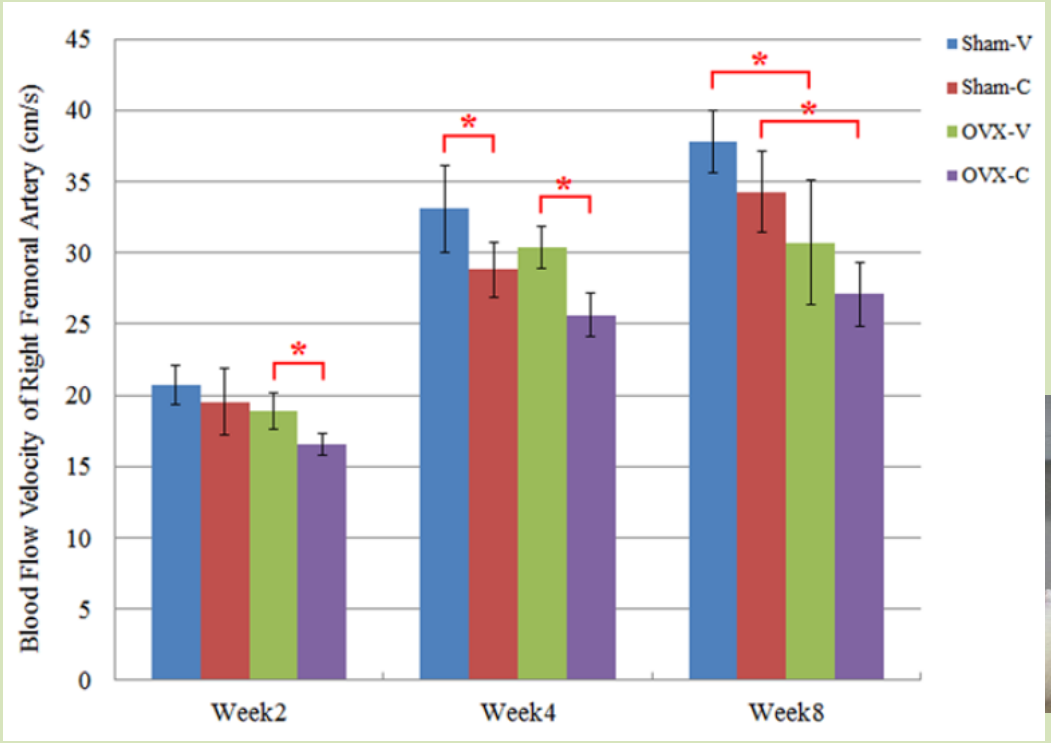
Dick Ho-Kiu Chow, Kwok-Sui Leung, Ling Qin, Andraay Hon-Chi Leung, Wing-Hoi Cheung

J Orthop Res. 29:746-52, 2011.

- CG: control; BG: bisphosphonate VG: vibration: VBG: bisphosphonate + vibration
- Vibration can counteract bone remodeling inhibition by bisphosphonate
- Implicate vibration can enhance bone remodeling in fracture healing



Vibration Enhances Angiogenesis in Fracture Healing

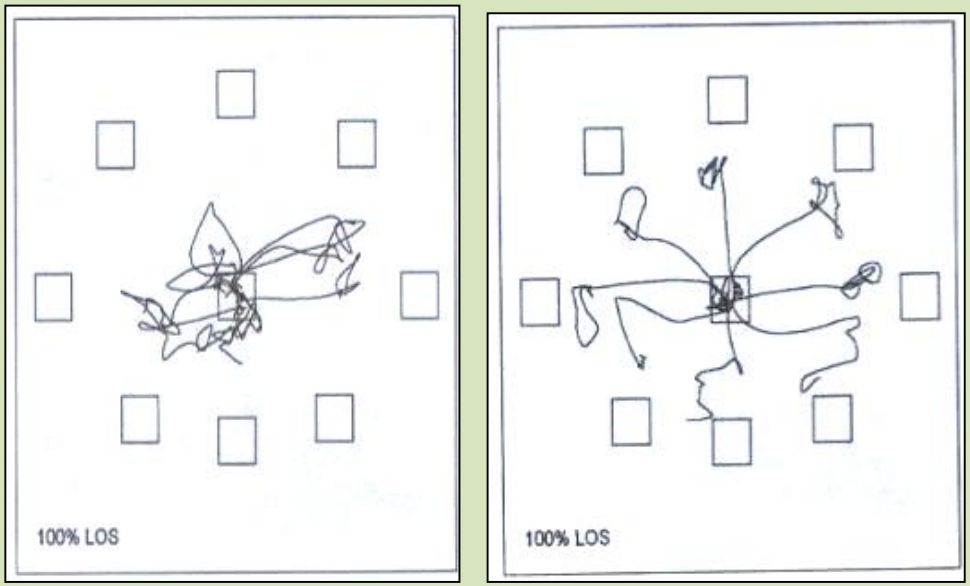


Vibration Improves Balancing Ability in Postmenopausal Women

High-Frequency Whole-Body Vibration Improves Balancing Ability in Elderly Women

Wing-Hoi Cheung, PhD, Hoi-Wa Mok, HD, Ling Qin, PhD, Pan-Ching Sze, BSc, Kwong-Man Lee, PhD, Kwok-Sui Leung, MD

Before



After

Table 2: Limits of Stability and Function Reach Compared Between Control and WBV Groups

Parameter (% change)	Control (n=24)	WBV Treatment (n=45)	*P*
Reaction time (s)	−25.59±24.37	−34.47±26.03	.210
Movement velocity (deg/s)	14.96±31.72	53.49±54.38	.003†
Endpoint excursion (% of limits of stability)	11.12±33.46	20.36±30.07	.261
Maximum point excursion (% of limits of stability)	3.36±20.91	18.84±18.26	.003†
Directional control (% of accuracy)	−6.61±19.72	4.32±19.64	.049*
Functional reach (cm)	6.59±34.56	23.77±63.01	.221

NOTE. Values are mean percentage change ± SD.
*$P<.05$.
†$P<.01$.

Summary – Biological Effects of Vibration Treatment

- Beneficial for musculoskeletal system
- **Bone**
  - Bone mineral density: spine, lower limb
- **Fracture Healing**
- **Muscle**
  - Balancing, jumping height, lower limb extension strength, low back pain
- **Circulation**
  - Blood flow at lower limb
- **Hormonal**
  - Growth hormone, Testosterone
- **Pain Relief**

Vibration Platform

Osteoarthritis

- Exercise
- Medications
  - Glucosamine sulphate
  - Hyaluronic acid
  - Interleukin-1 antagonist
    - Diacerein (Artrodar@)
    - Resveratrol白藜蘆醇
- Arthroscopic surgery
- Total joint replacement
- ?Stem cells

Diacerein

Rhubarb 大黄茎

Professor John Charnley, Center for Hip Surgery, Wrightington, England

Total Joint (Hip) Replacement

Small Polished and Double Tapered Stem (of the Exeter Hip) in Chinese Patients

Department of Orthopaedics & Traumatology
Prince of Wales Hospital
KH Chiu, KW Cheung, KY Chung, WY Shen
Nov 2011

31st HKOA Annual Congress, 2011

Exeter Hip Stem Features

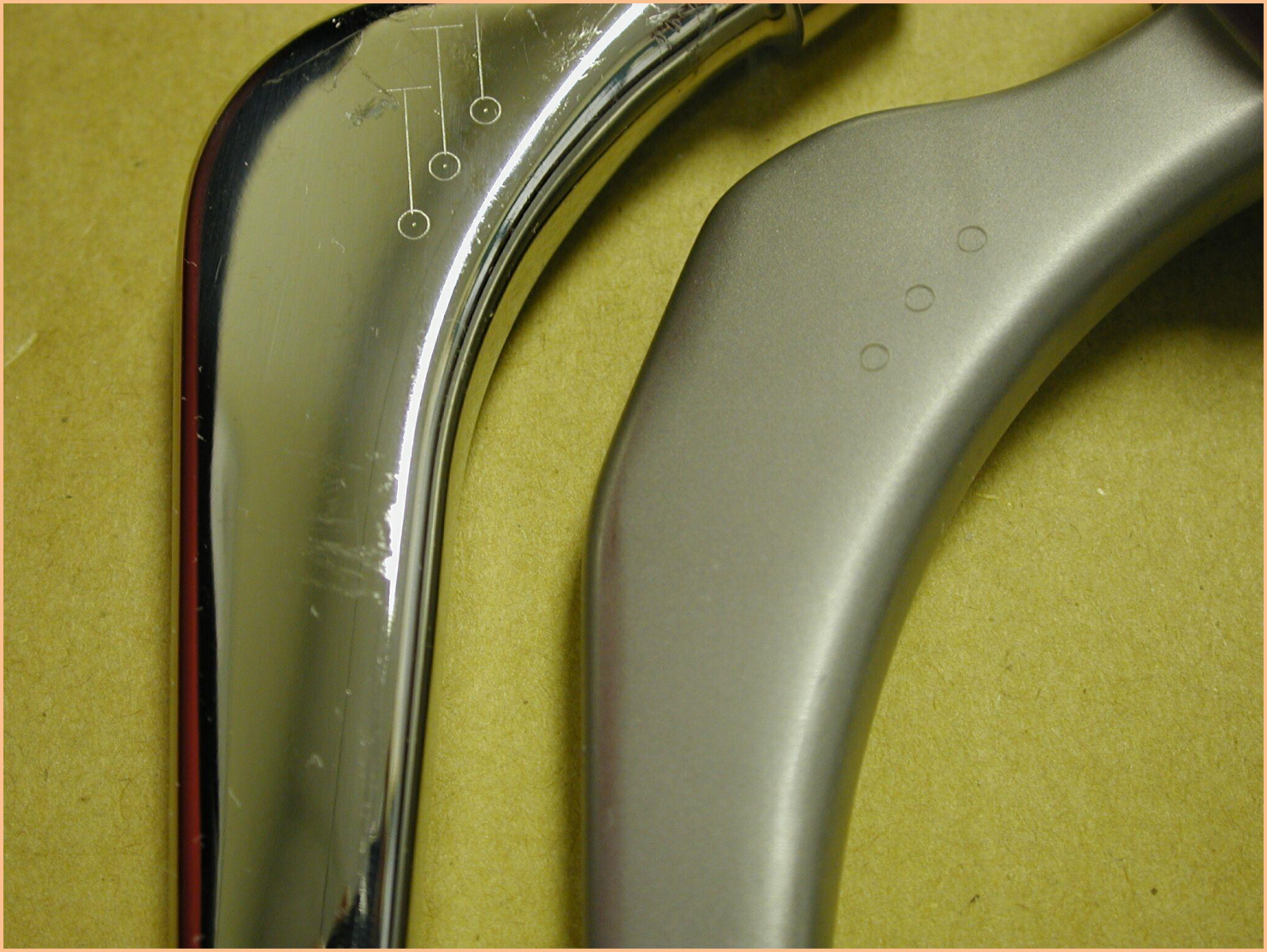
- Collarless
- Double taper geometry
- Highly **polished** surface
- Centralizer with “void”
- Orthinox (stainless steel),

modular stem with a Morse Taper neck, 22 to 32mm heads

Professor Robin Ling, Princess Elizabeth Orthopaedic Hospital, Exeter
英国埃克塞特

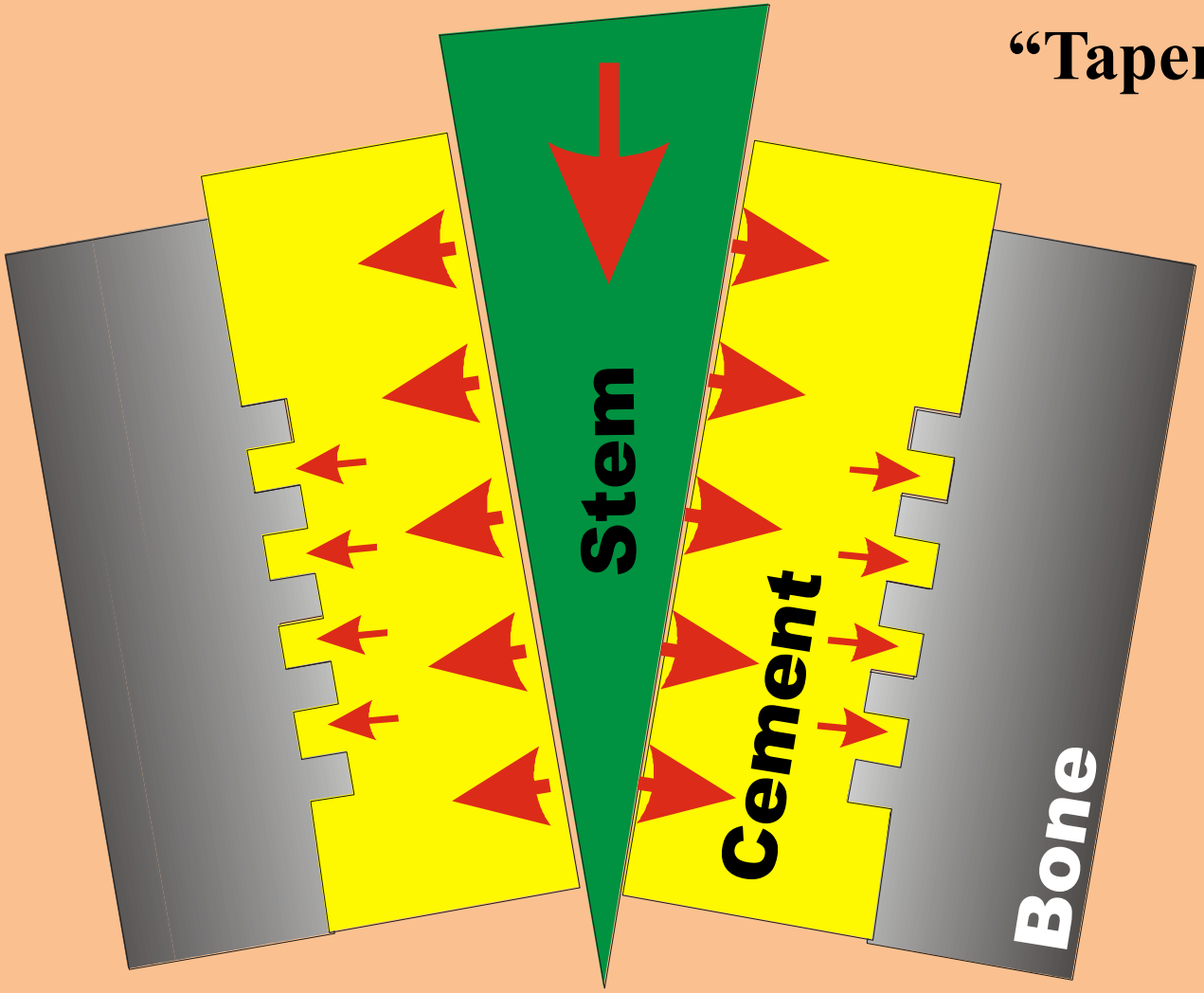
Exeter Universal Stem (1988)

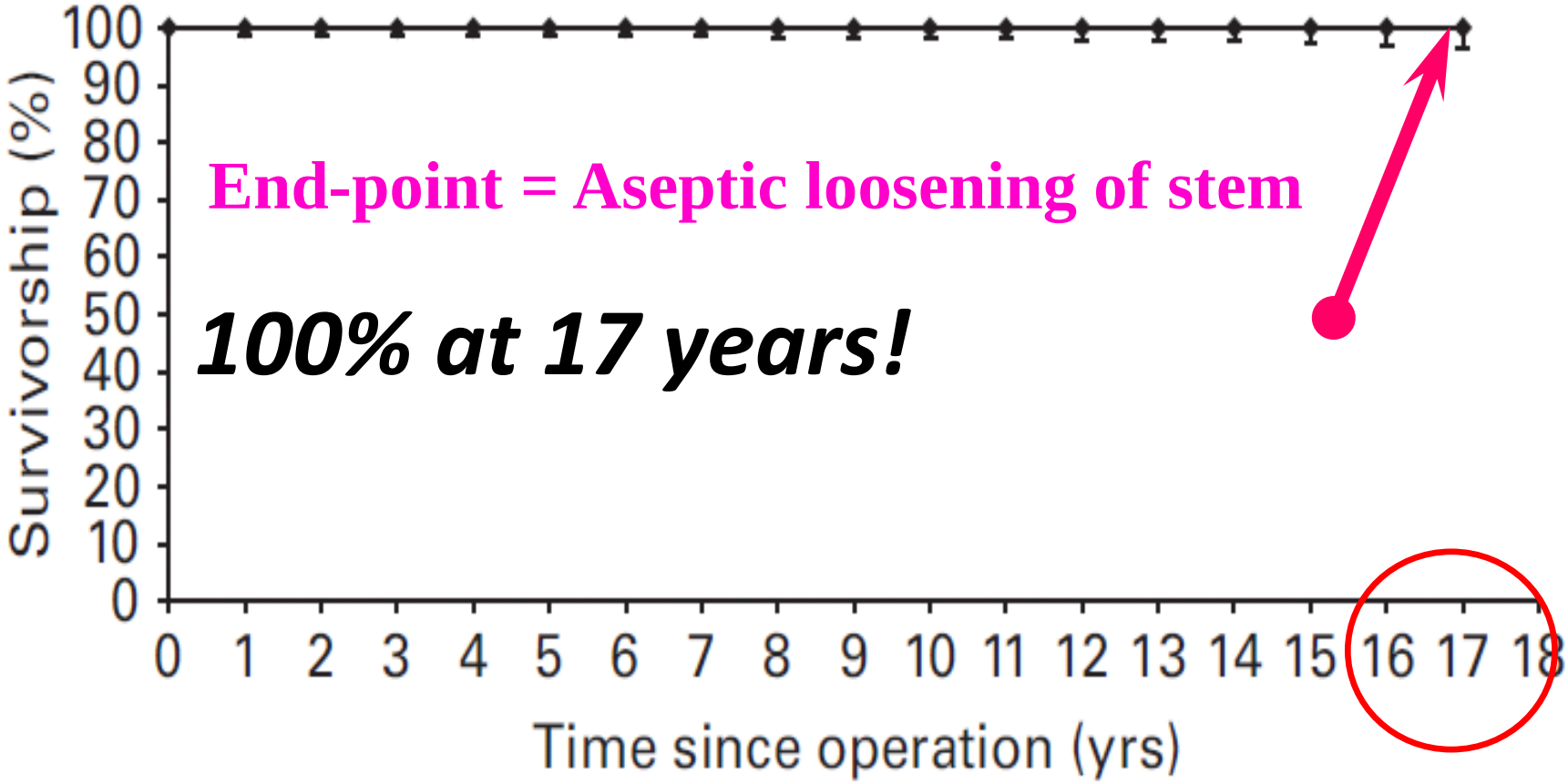
The **Polished** vs. Matte Stem



Polished Taper

“Taper-slip” design





The Exeter Universal Cemented Femoral Component at 15 to 17 Years

Carrington NC et al, JBJS 91B: 730, 2009

Our previous study in Exeter stem

Chiu KH, Shen WY, Cheung KW, HF Tsui et al. Primary Exeter total hip arthroplasty in patients with small femurs: a minimal of 10 years follow-up. J Arthroplasty 20:275, 2005

- 75 hips in 67 patients (Jul 1986 to Dec 1992)
- Only standard femoral implants available (37.5mm offset) , all polish-surfaced stems
- Average FU **12.8** years (range 10 to 16.5 years)
- Harris hip score improved from 39.8 to 82.3 at last follow-up
- 8 hips (6 stems and 2 cups) revised at 5 to 14 years because of aseptic loosening
- For aseptic loosening, stem survival **93.3%** at 10 years and **86%** at 15 years

Optimal Stem Size

- Complete cement mantle
  ≥ **2 mm** all round
- Enough metal for strength
- Near-anatomical offset

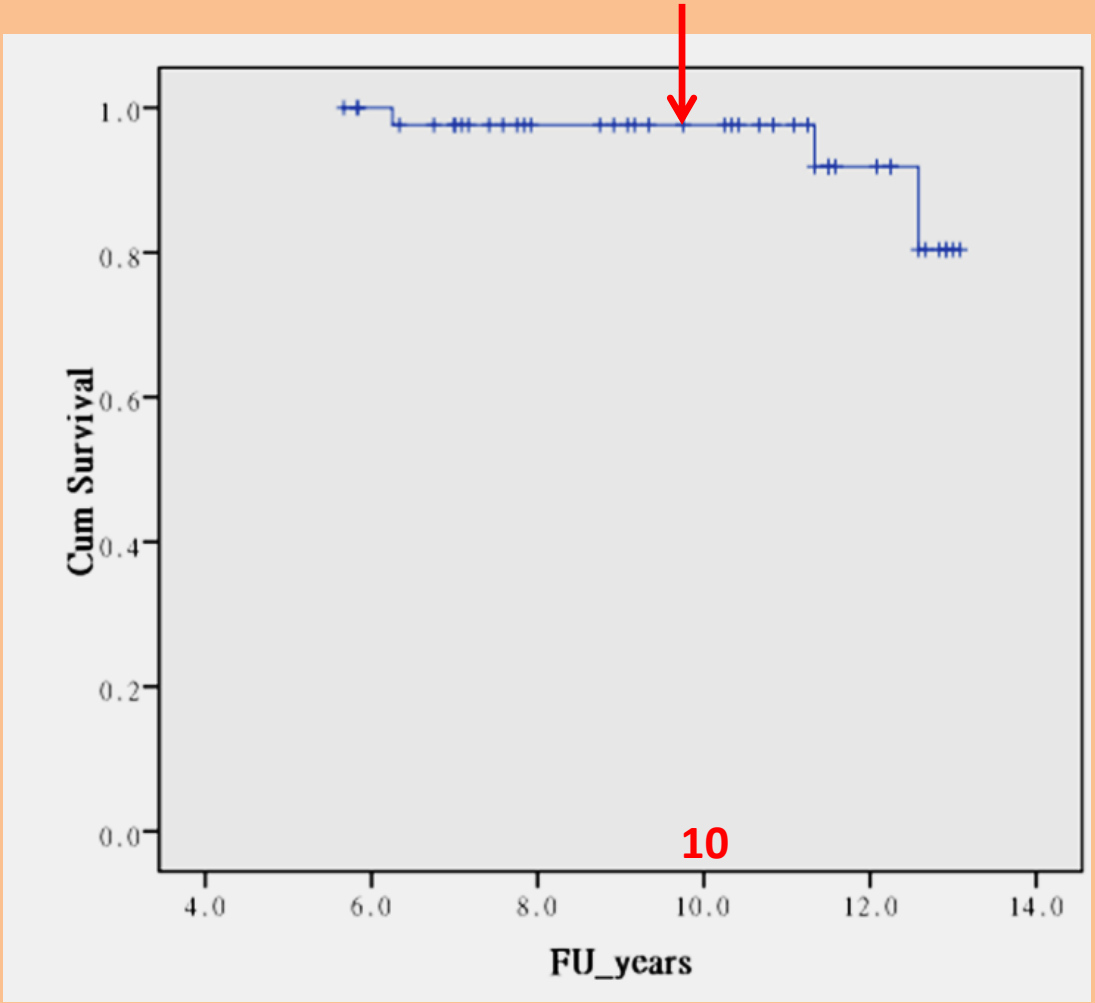
Small Exeter Femoral Stem in Primary Total Hip Arthroplasty in Chinese Patients

Materials and Methods

- **Prospective cohort**
- 102 hips in 92 Chinese patients underwent primary THA using the cemented Exeter femoral stem (Jul 1998 to Dec 2005)
- 55 patients with 59 hips (57.8 %) used the Exeter small stems (offsets 30 mm, 33 mm and 35.5 mm)
- 2 patients (2 hips) defaulted follow-up and 11 patients (12 hips) died of unrelated causes
- **42 patients (45 hips)** using the small Exeter femoral stems were available for assessment

- 8 males and 34 females
- Mean age at operation 70.2 years (range, 60 to 83 years)
- Average body weight 55.6 Kg (range, 33 to 78 Kg); average height 150.8 cm (range 137.2 to 164.4 cm)
- Diagnoses: dysplastic hip (44.4 %), avascular necrosis (28.9 %), osteoarthritis (17.8 %) and previous fracture (8.9 %)

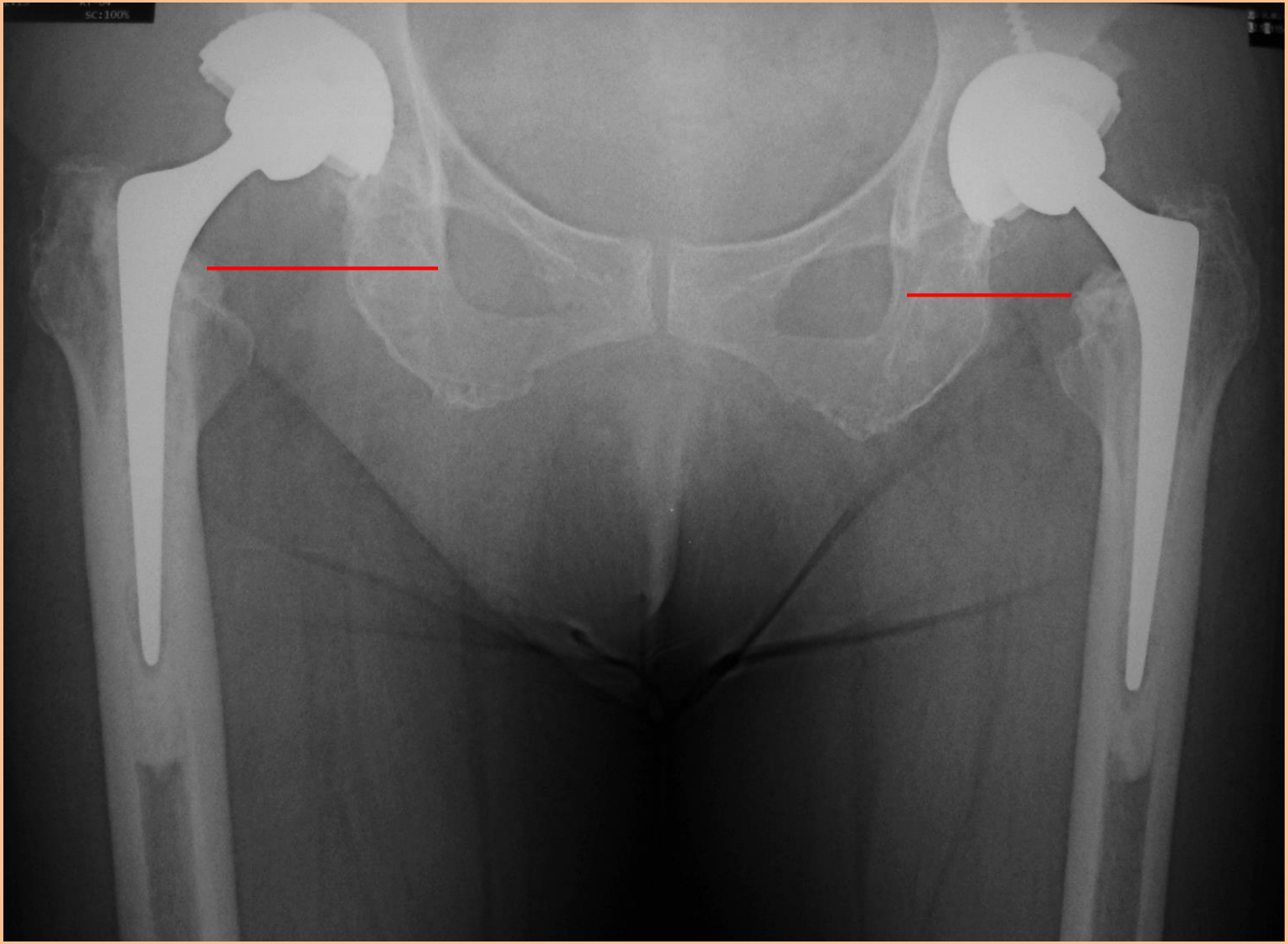
Stem survivorship



Using revision as an end-point, the overall survival rate 97.6% at 10 years, 91.8% at 12 years and 80.4% at 13 years

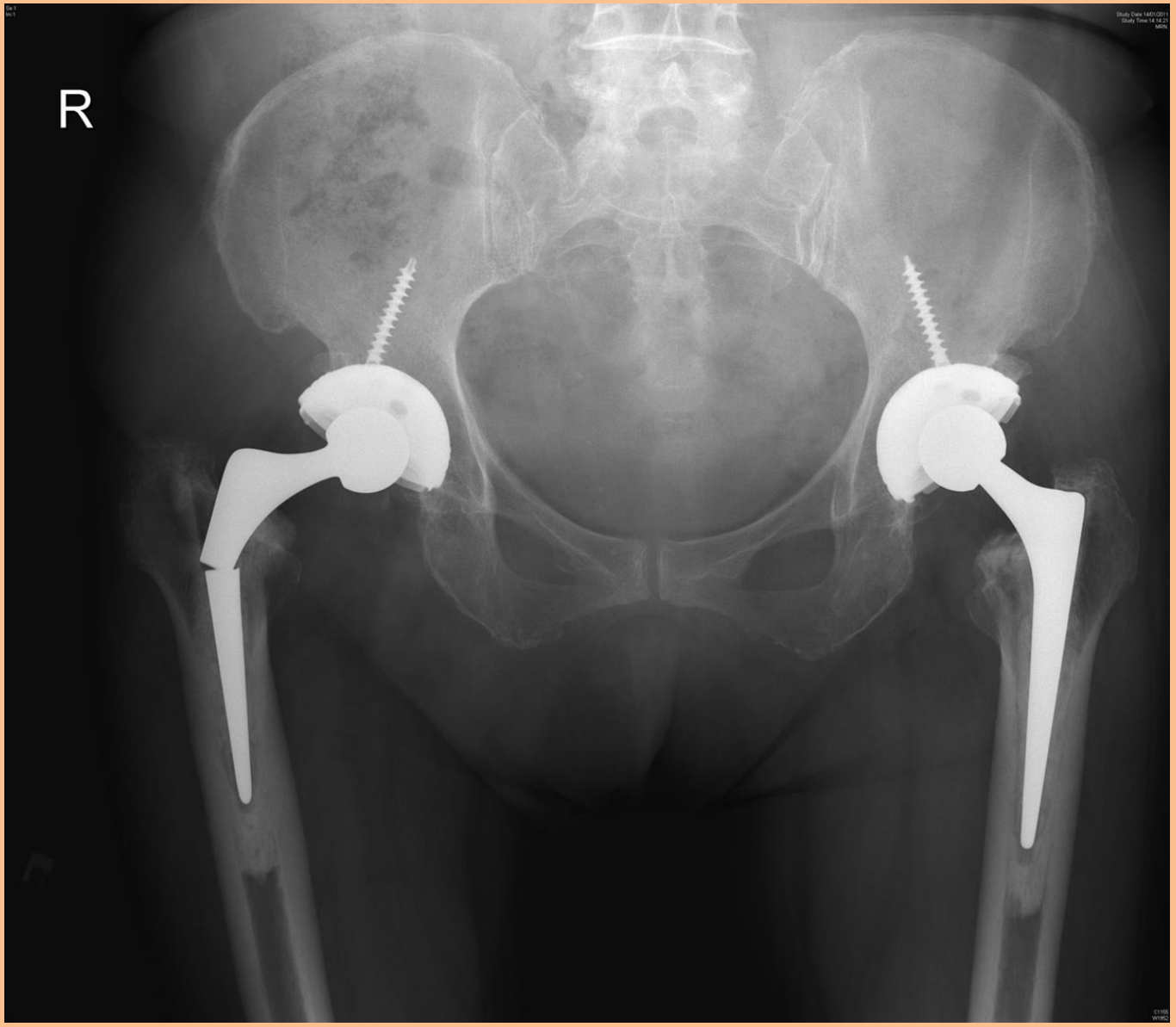
For aseptic loosening (fracture stem regarded as Gruen's Mode IV aseptic loosening), survivorship of **97.6%** at 13 years. *Gruen TA et al. CORR 141: 17,1979*

- Revision cases
  - One 33 mm stem fracture at 6 years
  - One Exeter cup revised at 10.7 years because of **aseptic** loosening
  - One excisional arthroplasty because of pathological fracture due to osteoradionecrosis (stem well fixed) at 11.5 years
  - One delayed infection at 12.4 years



5.5 years

3.5 year



6 years

Passed away patients

- **11 patients with 12 hips** at an average age of 80.3 (range, 75 to 92) due to unrelated causes
- At average of 6.3 years (range, 5 month to 11.5 years) after the THA
- Average Harris hip score 76 at the last follow-up (range, 55 to 90)
- Last X-rays showed stem subsidence within the cement mantle in 2 cases but no other evidence of stem loosening

Osteoporotic fracture

- Early fixation
- Early ambulation
- Medication for remineralization
- Nutritional support

Trochanteric Fractures in the Elderly

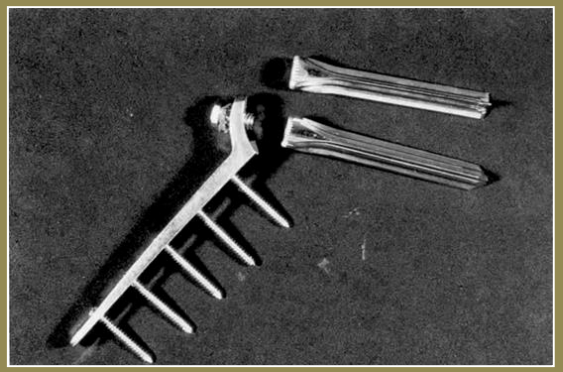
Problems

- Osteoporotic fractures
- Comminutions
- Displacements
- Poor candidates for surgery

The Evolution

Static fixation

- Fixed angle
- Adjustable angle
- Intramedullary

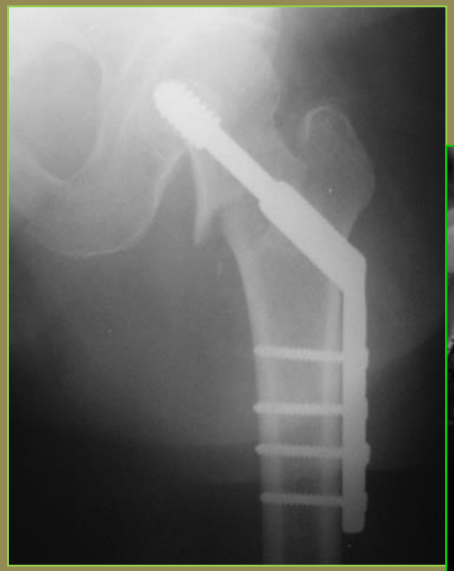


Dynamic Fixation

Controlled impaction

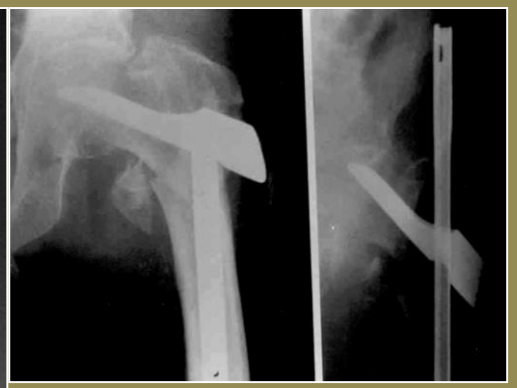
Enhances fracture healing

Medialises shaft fixation



Intramedullary Fixation

- Y-nail
- **Gamma nail**
- Others designs



Management of Trochanteric Fractures in the Elderly

Gamma nail

Dr. N Tang/ Prof. KS Leung
Department of Orthopaedics and Traumatology
Prince of Wales Hospital

The Improvements

Asiatic Gamma Nail

Asia-Pacific Technical Committee

CLINICAL ORTHOPAEDICS AND RELATED RESEARCH
Number 323, pp 42–48
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Geometric Mismatch of the Gamma Nail to the Chinese Femur

CLINICAL ORTHOPAEDICS AND RELATED RESEARCH
Number 323, pp 146–154
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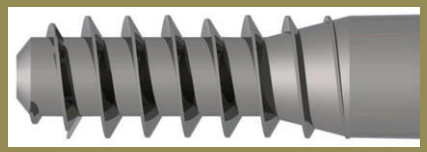
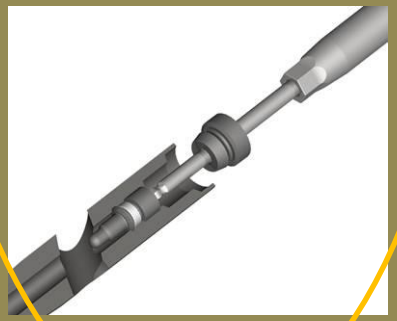
Multicenter Trial of Modified Gamma Nail in East Asia

K. S. Leung, MBBS, MD; C. M. Chen, MD**; W. S. So, MBBS†; Katsumi Sato, MD, PhD††; C. H. Lai, MBBS§; B. Machaisavariya, MD//; and S. Suntharalingam, MD¶*

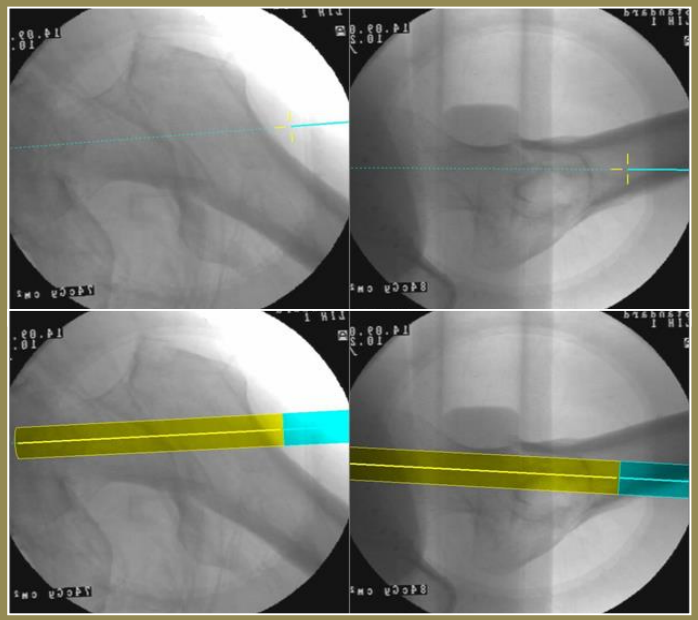
Gamma-3 Nail

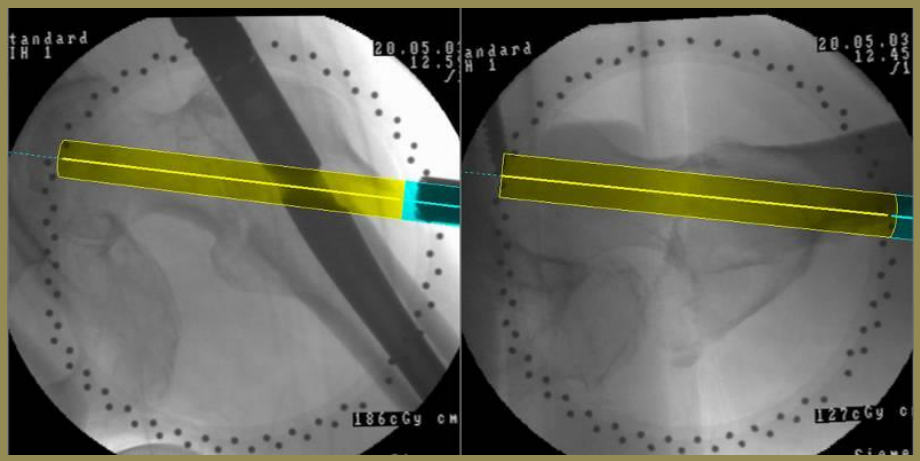




Fluoro-navigation in Trochanteric Fracture Fixation

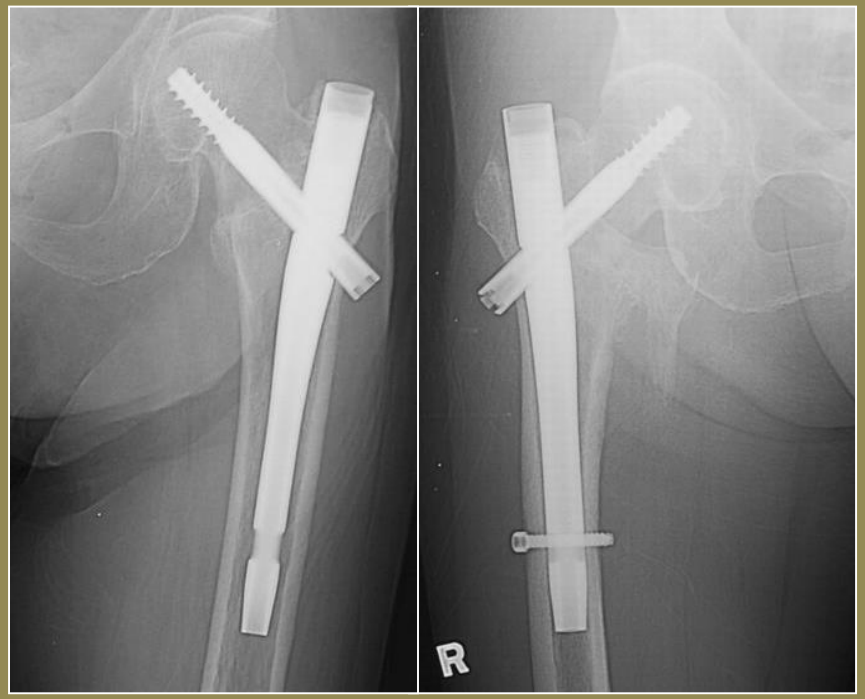
- Enhancing MIS
- Improving accuracy of implant position
- Minimising X-ray exposure
- Minimising complications





Results

- X-ray decreased with navigation assistance
- Wound length decreased with the instrument and navigation assistance
- Position of the lag screw can easily be controlled

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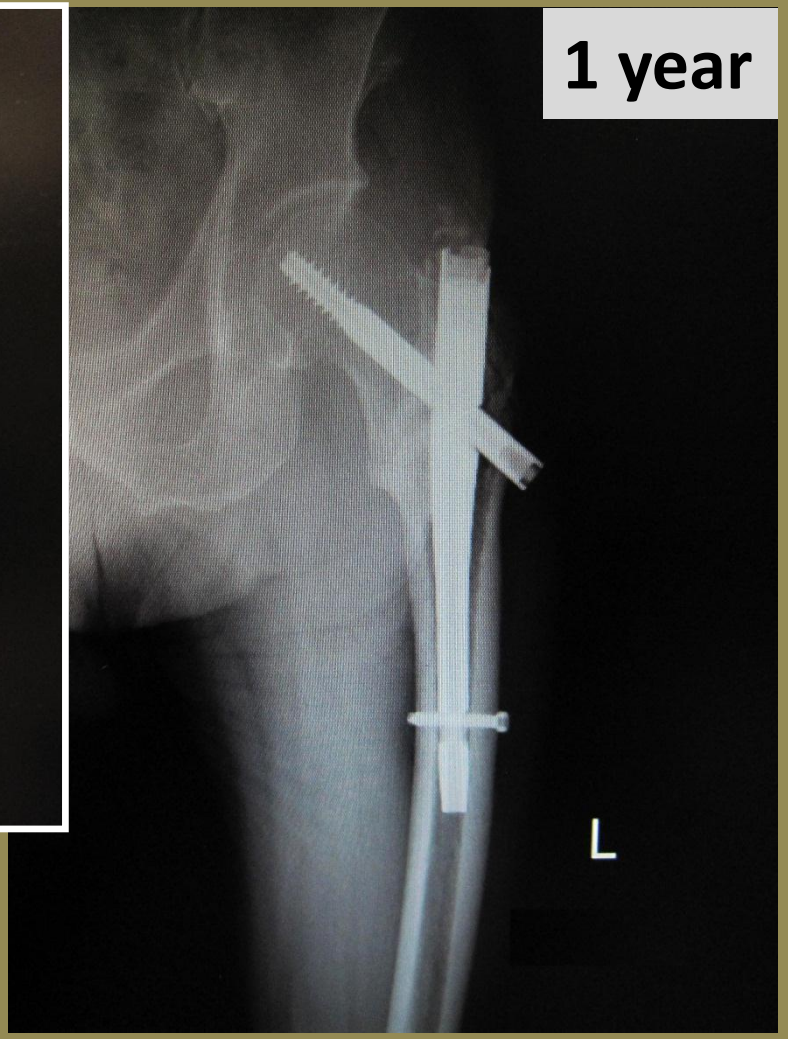
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Musculoskeletal Problems with Aging:
Prevention
Early Intervention
Expert management
Continual Research & Improvement