

# Fragility Fractures in the Elderly

## A Global Problem



KS Leung

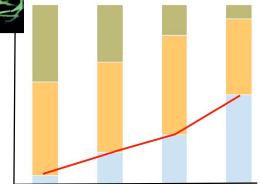
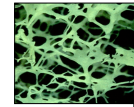
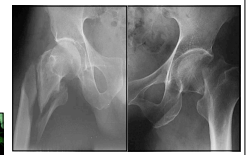
Community Fracture Prevention Working Group  
Department of Orthopaedics and Traumatology  
The Chinese University of Hong Kong



# The Silent Epidemics

## Fragility fractures

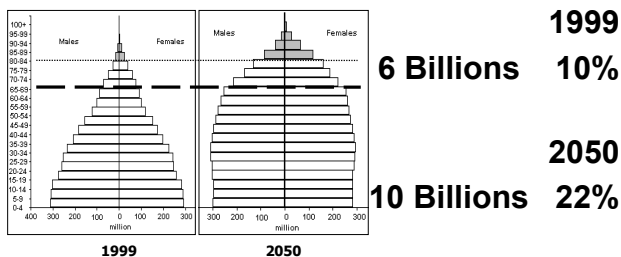
- ◆ Aging population
- Osteoporosis
- Co-Morbidities
- ◆ Increased risk of injuries
- Falls
- Active life style



50-59 60-69 70-79 >80

# Causes- an aging world

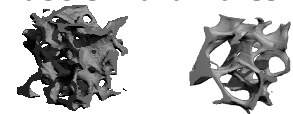
## Geriatric population



(WHO-1999)

# Causes of Fragility Fractures

- ◆ Aging population
- ◆ Deterioration in bone quality
- ◆ Deterioration in muscle IIa b fibres
- ◆ Risk of falls



## Global phenomenon

- Decrease in high energy trauma
- Longer life expectancy
- More active life style

# Fragility Fractures

## 脆性骨折

50% women and 30% men after 50 years old will get a fragility fracture in their remaining life!

# Increasing Number of Proximal Femoral Fractures

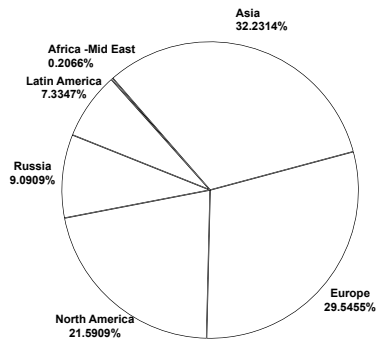
## 股骨近端骨折的数量逐年增多

1992	1.66M	166万
2025	3.94M	394万
2050	6.26M	626万

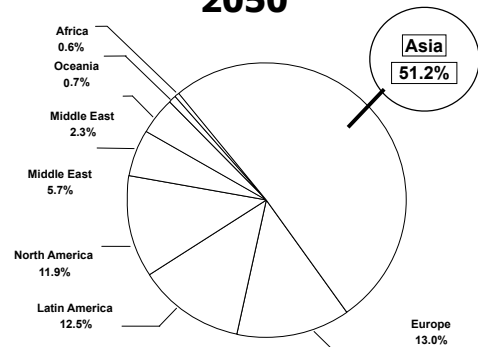
89% - Osteoporotic Fractures!

89%为骨质疏松脆性骨折!

## Hip Fractures in Geriatric Women 老年女性髋部骨折 1990



## Hip Fractures in Geriatric Women 老年女性髋部骨折 2050

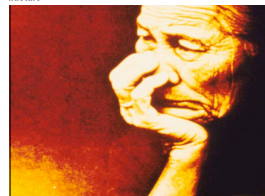
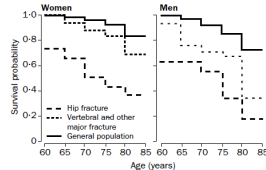


## Hip Fractures 髋部骨折

**Disabilities 残疾**  
**Quality of life 生活质量**

**Mortality 死亡率**  
15% higher in first year  
第一年内死亡率增加15%  
4% in first 4 months  
前4个月内4%  
40% within 4 years  
4年内40%

**Medical cost 医疗费用**  
**Expensive 高昂**



## Quality of Life 生活质量

**After hip fractures 髋部骨折后**

80% deterioration in mobility 活动能力下降  
10% ADL dependent 日常生活不能自理  
19% long term nursing home 长期居住疗养院  
60,000 AH admissions/yr (USA) 每年60000例 (美国)  
30% home bound 因病在家

## Socio-economical Implication 社会经济影响

**Expenditure on Geriatric Hip Fractures 2001**  
髋部骨折的花费 (2001年)

USA 美国	\$ 17 b	170億
UK 英国	£ 1.7 b	17 億
Australia 澳大利亚	\$ 2.5 b	25 億
European Community 欧洲	\$ 4 b	40 億
Hong Kong 香港	\$ 0.2 b	2 億
China 中国	\$ 2 b	20 億

## Fragility Fractures

### ◆ Acute management

- Surgery
- Research and studies

### ◆ Rehabilitation

- Sustainable
- Focused

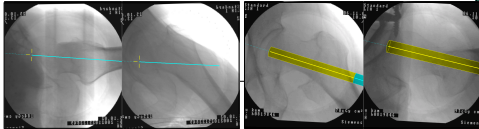
### ◆ Prevention

- Primary and Secondary
- Bone quality – osteoporosis
- Falls

\* Incidence  
\* Effects

# Clinical Problems

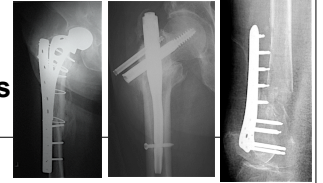
- ◆ Large patient load
  - Medical and anesthetic complexities
  - Fracture characteristics
- ◆ Choice of methods
- ◆ Choice of implants



# Surgical Management

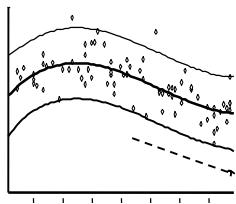
## Advancement in Technologies Understanding of Pathologies

- ◆ Distal radial fracture
- ◆ Proximal humeral fracture
- ◆ Elbow fractures
- ◆ Proximal femoral fractures
- ◆ Distal femoral fractures
- ◆ Periprosthetic fracture
- ◆ Vertebral fractures



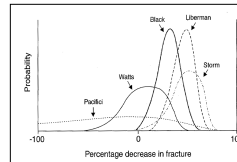
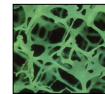
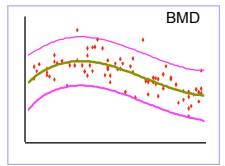
# Prevention Strategy

- ◆ Improving bone quality
  - ❖ Maintain bone mass
  - ❖ Treat osteoporosis
    - Drugs
    - Physical stimulations
- ◆ Preventing fall
  - ❖ Exercise and Biophysical stimulations
  - ❖ Treat medical problems
- ◆ Minimising injury effects of falls



# Improving Bone Quality

- ◆ Prevention of osteoporosis
  - Life-long task
- ◆ Maintenance of bone mass
  - Drug
  - Exercise
  - Intervention



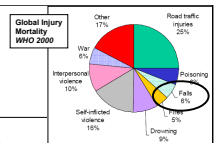
# Improving Bone Quality

- ◆ Medications
  - ❖ Anti-resorption - bisphosphonates
  - ❖ Anabolic - Sr, SERM, Ca, Vit D, PTH
- ◆ Biophysical intervention
  - ❖ Exercise - weight bearing
  - ❖ Vibration - high frequency/low amplitude
  - ❖ Shockwave - ? invasiveness
  - ❖ Ultrasound - ? effect on osteoporotic bone



CORR 2004, KS Leung et al

# Epidemiology Falls in Elderly



**The Problem - Falls are a serious public health problem among older adults.**

- More than a third of elderly fall at least once each year (Hornbrook 1994; Hausdorff 2001).
- 50% of elders who fall, do so repeatedly.
- 20% to 30% fallers suffer moderate to severe injuries that reduce mobility and independence, and increase the risk of premature death (Alexander 1992).
- Elderly are five times more likely to be hospitalized due to falls than to injuries from other causes (Alexander 1992).
- Falls
  - 29% of injury deaths among elderly
  - 3<sup>rd</sup> cause of the death from unintentional injuries (USA)

# Falls



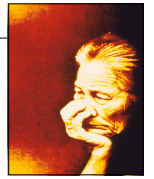
- ◆ 35-45% of age >65 fell annually
- ◆ 10-25% falls resulted in fractures
- ◆ 6% medical expenditure of >65
- ◆ 5% required hospitalisation
- ◆ 4<sup>th</sup> cause of bed occupancy
- ◆ 40% admission to age home
- ◆ Fear of fall – ↓ quality of life
- ◆ 29% injury death in elderly

[www.no-fall.hk](http://www.no-fall.hk)

# Increased risk of Falls

## Data from Hong Kong

- ◆ Community – Survey 2800 elderly
  - 51% have fall
  - 16.8% had fall within 1 year
    - ★ 1/3 had recurrent falls
  - 68% needed medical care
- ◆ 3105 elderly attended PWH A&E for fall injuries
  - 46.7% of all trauma cases
  - Male: female = 1:3
  - Average age: 77 years old
- ◆ Orthopaedic wards
  - 875 fractures elderly within 18 month
  - All related to fall
  - Male: Female = 1:7
  - Average age = 79 years old



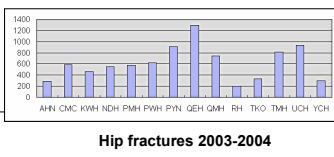
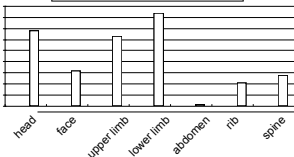
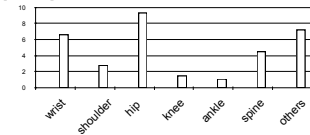
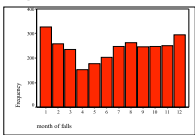
# Increased risk of Falls

## Data from Hong Kong

Survey on 14 Accident and Emergency departments in 2003:

Total no. trauma cases: 58040

Injuries due to Falls: 38820 (65%)



Hip fractures 2003-2004

# Concept of Fractures Prevention

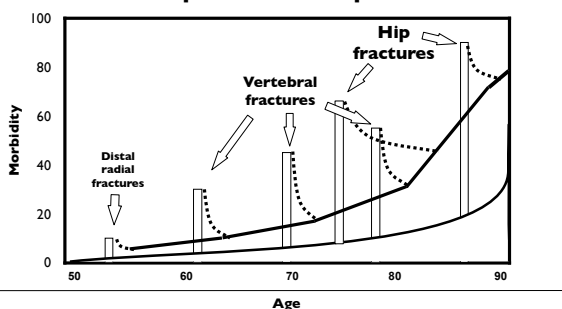
*No Fall, No Fracture!*

- ◆ Preventing Falls
  - Primary: education
  - Secondary: minimising impact
  - Tertiary: post-fracture measures
- ◆ Preventing secondary fractures
  - Injuries after first fracture
  - Tertiary prevention strategy



# Fracture is the First Chance to Manage Osteoporosis

## Osteoporotic Life Experience



Modified from: Kanis JA & Johnell O, J Endo Investigation, 22: 583-288, 1999

# Our Actions

## A Comprehensive Program

Out-reach Community Based Primary Prevention Program

- ◆ Educational talks
- ◆ Train the trainers courses
- ◆ Staff training courses
- ◆ Increase public awareness
- ◆ Professional led program
  - Surgeons
  - Nurses
  - Rehabilitation specialists
  - Social workers



# Fall and Fracture Prevention for Elderly in Hong Kong

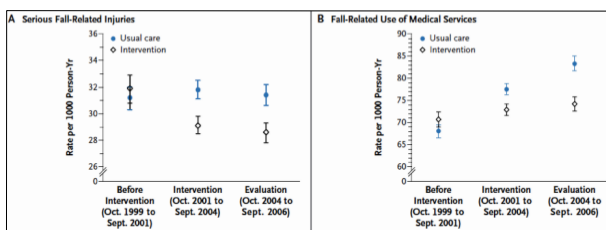
## A Comprehensive Community Based Program 2000

# Education Materials

- ◆ Brochures
- ◆ Video-CD exercise
- ◆ AV material
- ◆ [WWW.No-Fall.hk](http://WWW.No-Fall.hk)



## Results of Multidisciplinary Intervention Community program

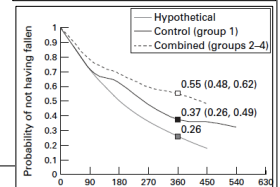
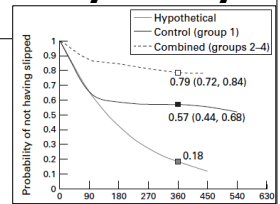


- ◆ 6 years controlled study in 2 regions
- ◆ 9% decrease in serious fall related injuries
- ◆ 11% decrease in fall related use of medical services

ME Tinetti et al, N Engl J Med 359:3, 2008

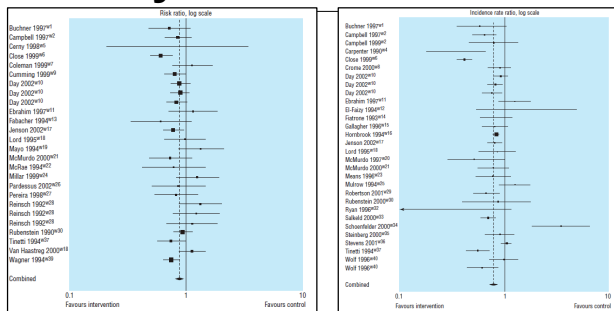
## Randomised Controlled Study on Fall Prevention in Community Elderly

- ◆ 4 study groups
- ◆ Multi-interventions
  - Talks
  - Exercise classes
  - Home safety
  - Clinical assessments
- ◆ Results
  - 58% decrease in risk of skid
  - 64% decrease in knock down
  - 30% decrease in falls



M Steinberg et al. J Epidemiol Community Health 2000;54:227-232

## Cochrane DataBase Systemic Review



Multiple interventions are effective in reducing falls!

## Fall and Fracture Prevention Centres

- ◆ Regular programs
- ◆ Risk assessments
- ◆ Home visits
- ◆ Training of staff
- ◆ Interest groups
- ◆ Exercise classes
- ◆ Vibration therapy



## Fall Risk Assessment



## Education Program

- Increase awareness
- Community talks
  - Multi-discipline
  - Multi-media
  - Interactive
  - Hand-out
  - Recruitment



## Community Talks

**Targets: Senior community-dwellers**

**Aims:**

- Knowledge
- Awareness
- Attitude
- Behaviour modification



## Train the Trainers Course

- Targets:
  - Senior Volunteers
  - Perimenopausal women
- A three day program on
  - Education on fall prevention
  - Home visits skills
    - Simple risk of fall assessment
    - Survey
    - Environmental hazards
  - Fall prevention exercise
  - Practice of talks



## Staff Training Course

To plan and organise prevention programs

- Professional information
- Presentation skills
- Planning and organisation
- Special skills
  - Risk assessment
  - First-aid
  - Exercise
  - Self-care
- End of training test



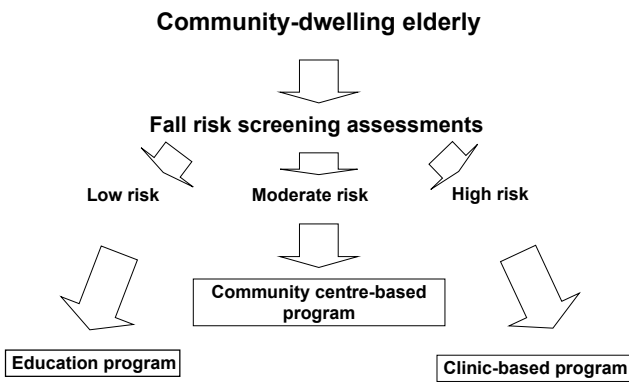
## Perimenopausal Women Program

- Early prevention of fall and fracture
- Habit building
- Carer for elderly at home

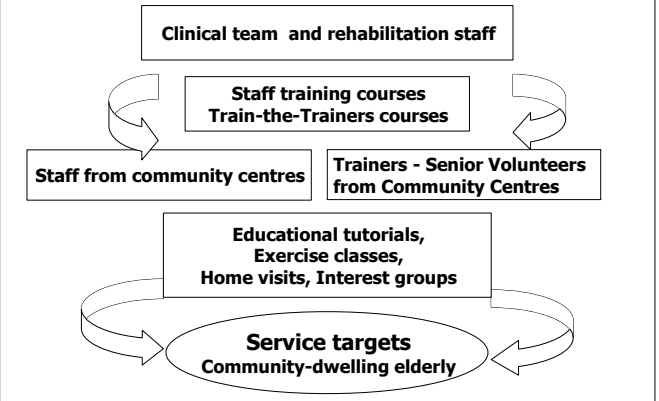
- Program:**
- Train-the-trainers
  - Factual knowledge
  - Caring techniques
  - Simple risk assessments
  - Home visit skills
  - Exercise conducting



# Three-Tier Program



# Community Centre-based Program



# Community Centre-based Program

**Home visits and modification program**  
預防長者跌倒及骨折  
社會服務計劃  
長者防跌  
健體十式

**Exercise program**

**Community education and promotion**

# Interest Groups

- To sustain the prevention activities in a community
- To monitor the fall incidences
- To refresh the prevention information
- To update the prevention strategy
- To share the experience

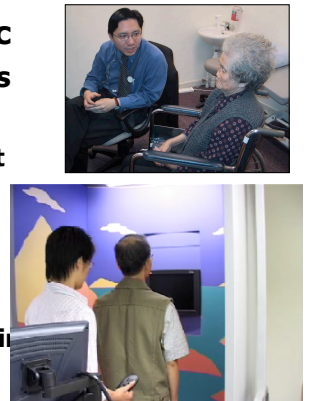
# Community Program 2000-2009

	Number	Participants
Talks for Elderly	268	25200
Talks for Women	13	955
Elderly Volunteer Training	44	1311
Women Volunteer Training	14	347
Staff Training	7	194
Young Volunteer Training	1	34
<b>Total</b>	<b>347</b>	<b>28041</b>

# Clinic-based Program

## Fall prevention clinic

- Detailed Assessments
- Physician
  - Medication adjustment
  - Referrals to other specialties
- Physiotherapist
  - Balance training
  - Individual/group training



## Balance Training



## Fall Prevention Clinic

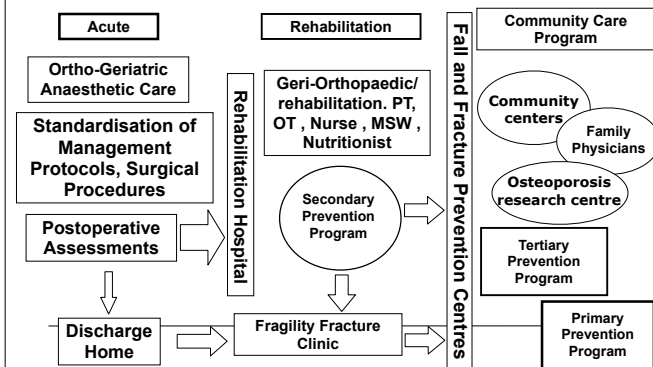
57 elderly with training for one year

- ◆ Significant improvement in Functional balance test
  - Berg Balance Scale ( $p=0.002$ )
- ◆ Improvement in sensory organization (SmartEqui Tests) :
  - Disrupted somatosensory input ( $p=0.1272$ )
- ◆ Self-evaluated confidence level
  - Significant improvement in mean score ( $p=0.0033$ )
- ◆ Number of falls decreased from 3.75 to 1.5 ( $p=0.021$ )



Sze PC, Cheung WH, Lam PS, Lo HS, Leung KS, Chan T. The efficacy of a multidisciplinary fall prevention clinic with an extended step-down community program. Arch Phys Med Rehabil. 2008;89:1329-34

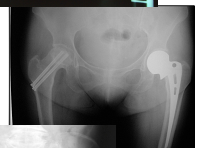
## Comprehensive Care for Elderly with Fragility Fractures



## Rate of Secondary Fractures

Critical Period: First Year after Fracture

- ◆ 5-10% within 1 year
- ◆ 9.9% non-vertebral fractures
- ◆ Follow up 837 elderly fractures due to falls:
  - Recurrence of falls:
    - ◆ 9.3%
    - ◆ Hip fracture: 10.5%
  - Re-fractures:
    - ◆ 50% ( $p<0.001$ )



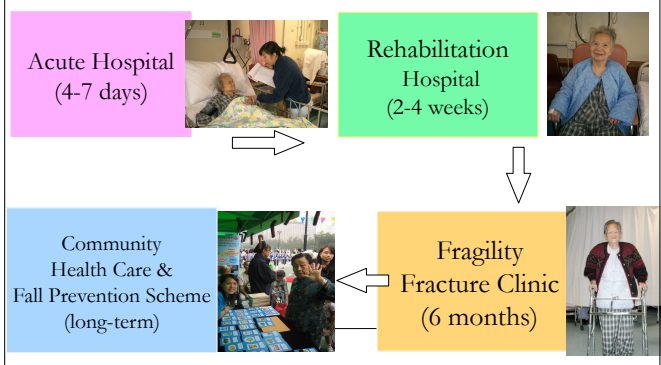
## Fall Prevention in Preventing Secondary Fractures

### The Strategies

- ◆ First fracture as a warning sign
- ◆ Screening ⇌ Assessments ⇌ Interventions
- ◆ Preventive measures
  - Primary - risk identification
  - Secondary - protection
  - Tertiary- No Fall, No Fracture!



## Comprehensive Management of Geriatric Hip Fractures



## A Patient Focused Program *Acute Stage*

- ◆ **Co-ordinated management**
  - Orthopaedic surgeons
  - Geriatricians
  - Anaesthetist
  - Nursing care
- ◆ **Standardisation of surgical procedures**
- ◆ **Assessments and evaluation**
- ◆ **Rehabilitation plan**
- ◆ **Introduction to the program**



## A Patient Focused Program *Rehabilitation*

- ◆ **Ortho-geriatric input**
- ◆ **Rehabilitation team**
  - Physiotherapist
  - Occupational therapist
  - Orthotist
- ◆ **Medical social service**
- ◆ **Psychological care**
- ◆ **Nutritional support**
- ◆ **Discharge plan**



## A Patient Focused Program *Fragility Fracture Clinic*

- ◆ **Assessments**
  - **Surgical and Medical**
    - \* Fracture healing
    - \* Physical abilities
    - \* Optimisation
  - **Physiotherapist and Occupational therapist**
    - \* Optimisation
    - \* Continuation of rehabilitation program
- ◆ **Preparation for community program**
  - **BMD measurement**
  - **Family and care taker**



## Fall and Fragility Fracture Clinic *Secondary prevention*

- ◆ **High risk group from FFPC**
- ◆ **Detail assessments**
- ◆ **Physician input**
  - ★ Drug modulation
- ◆ **Training program**
  - ★ Specific training
- ◆ **Home environment adjustment**
- ◆ **DXA measurement**
- ◆ **Anti-resorption drug**
- ◆ **Hip protector**



## A Patient Focused Program *Fall and Fracture Prevention Centre*

- ◆ **One-Stop Service at the Door Step!**
  - Medical care
  - Rehabilitation
  - Fall and fracture prevention
  - Psycho-social support
- ◆ **Support from Specialists**
  - Orthopaedic support
  - Geriatric support
  - Rehabilitation support



## Preparation and Logistics

- ◆ **Public-Private services collaboration**
- ◆ **Patient data communication**
- ◆ **In-service training and education**
  - Orthopaedic surgeons
  - Family physicians
  - Rehabilitation therapist
  - Nurses
  - Medical social workers and front-line staff
- ◆ **Resources**

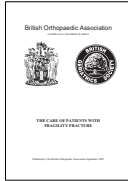




## Protocols Setting

- ◆ Surgical
- ◆ Medical
- ◆ Anaesthetic
- ◆ Nursing
- ◆ Rehabilitation
- ◆ Fragility Fracture Clinic
- ◆ Fall and Fracture Prevention Centre
- ◆ National and International registries

HOW TO  
MANAGE  
AN AGEING  
POPULATION



[www.no-fall.hk](http://www.no-fall.hk)



## Training of Teams

- ◆ Orthopaedic surgeons
  - Leader in the program
- ◆ Family physicians
  - Fall prevention
  - Osteoporosis
- ◆ Nursing and rehabilitation professions
  - Risk of fall
  - Exercise
  - Home environment
  - Nutrition
- ◆ Community centres
  - Fall prevention program



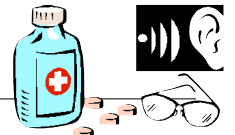
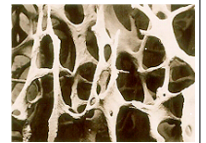
## Program for Orthopaedic Surgeons

- ◆ Organisation of Fragility Fracture Program
- ◆ Liaison and multidisciplinary approach
- ◆ Standardisation of fracture fixation
  - Pre-operative
  - Intra-operative
  - Post-operative
- ◆ Surgeon led program
  - Surgical management
  - Prevention and community based program



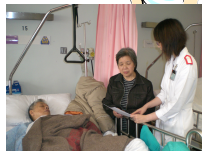
## Program for Primary Care Physicians

- ◆ Community program
  - Fracture and Fall Prevention
  - Poly-pharmacy
  - General geriatric management
- ◆ Timely referral
- ◆ Primary care and specialist collaboration
- ◆ Set up of Community Fracture and Fall Prevention Program
  - Sustainability
  - Efficiency
  - Effectiveness



## Program for Nurses and Paramedical Professions

- ◆ Acute management
- ◆ Rehabilitation
  - Acute
  - Rehabilitation hospitals
  - Fracture clinics
- ◆ Community program
  - Liaison
  - Prevention program
  - Extended and outreach program
  - Planning strategy



## Program for Community Workers

- ◆ Community participation
  - Front-line workers
  - Concept of Self responsibility of health
  - Self run programs
- ◆ Value-added programs
  - Sustainability
  - Establishing network
  - Opportunity for collaboration
- ◆ Planning and resources allocation





# Deliverables



- ◆ **Improved patient care**
  - Quick and complete recovery
  - Enhancing sustainable rehabilitation
  - Preventing secondary fractures
- ◆ **Promotion of bone health and fracture prevention in the community**
- ◆ **Primary and Specialist care collaboration**
  - Enhancing primary bone health care
- ◆ **Multi-disciplinary collaboration**
- ◆ **An integral part of Fall and Fracture Prevention Program in the Community**

# Encouraging Response

- ◆ **100% acceptance from patients and carers**
  - ❖ BMD - self-financed!
  - ❖ Anti-resorption drugs - self-financed!
- ◆ **Excellent support from the family members**
- ◆ **Excellent compliance to Community Centre activities**
- ◆ **Early discharge from Specialist Clinics**
- ◆ **Patient and family satisfaction**
- ◆ **Team satisfaction**

## Comprehensive Care for Elderly with Fragility Fractures

180 proximal femoral fractures. Results after 1 year intervention

Mobility	Before		After	
	Count	Percentage	Count	Percentage
Independent	7	19%	10	28%
Crane	13	37%	12	33%
Quadripods	3	8%	4	11%
Frame	0	0%	4	11%
Wheelchair	13	36%	6	17%
<b>Total</b>	<b>36</b>	<b>100%</b>	<b>36</b>	<b>100%</b>

## Comprehensive Care for Elderly with Fragility Fractures

180 proximal femoral fractures. Results after 1 year intervention

Assessments	Before (Mean ±SD)	After (Mean ±SD)	p-value
Timed up and go (TUG)	30.00±22.27	21.55±14.71	0.008
Elderly Mobility Score (EMS)	14.16±5.18	16.56±3.46	<0.001
Berg Balance Scale (BBS)	34.53±14.51	44.91±10.44	<0.001
Fall Risk Screening (I)	<b>Secondary Fracture : 0</b>		

Comprehensive Care for Elderly with Fragility Fractures

2007

Fall Clinic Based Program

2003

Comprehensive Community Fall and Fracture Prevention Program

2000

Funding : 21, total : HK\$ 8.89M

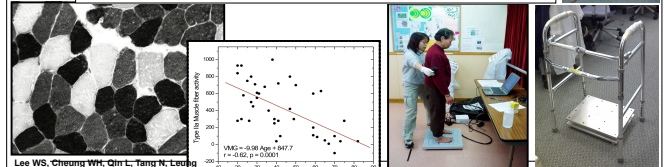
# Research and Development Programs

# Research Programs

- Epidemiology – citywide data
- Effect of different programs
- Simple and effective fall risk assessment
- Primary preventive measures
  - Exercise
    - Tai-chi: Simplified and specified
    - Resonance therapy- vibrational therapy
  - Three tier program
  - Shoe ware: design and manufacture
- Secondary preventive measures
  - Hip protectors
  - Floor designs – energy absorption
- Tertiary preventive measures

# High Frequency Low Magnitude Vibration in Treatment & Prevention of Fragility Fractures

- Improve BMD
- Improve muscle power
- Improve co-ordination
- En **One Stone - Two Birds**



Lee WS, Cheung WH, Qin L, Tang N, Leung KS. Age-associated decrease of type IIA/B human skeletal muscle fibers. *Clin Orthop Relat Res.* 450:231-237, 2006.

Cheung WH, Mok HW, Qin L, Sz PC, Lee KM, Leung KS. High-frequency whole-body vibration improves balancing ability in elderly women. *Arch Phys Med Rehabil.* 88(7): 852-7, 2007.

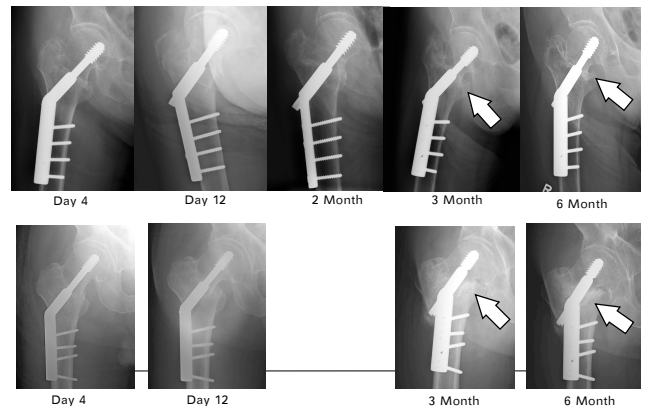
# LMFH Vibration on Geriatric Hip Fractures



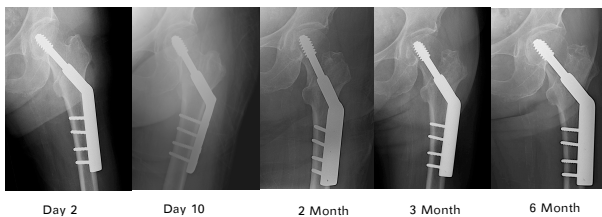
- ◆ Trochanteric fracture fixed with DHS
- ◆ Hypotheses
  - Enhances fracture impaction
  - Enhances fracture healing
  - Maintains muscle mass
  - Maintains bone mass
- ◆ Expected outcome
  - Enhances rehabilitation
  - Decreases complications
  - Prevents secondary fractures



# Preliminary Results



# Preliminary Results



1. Fracture impaction ~ 100% (Day 14 - 2 month)
2. Intramedullary callus ~ 80% (2 - 6 Month)
3. TAD unchanged (6 month)
4. Mechanical failure ~ 0% (6 Month)

# Anti-Fall Shoes

1. Antislippery sole
2. Easy to put on
  - sandals? not easy to fall off
  - Velcro fasteners
3. Complete sole contact
  - anterior arching
  - medial arch support
  - metatarsal bar
4. Wide head
5. Silicon padding
6. Strong posterior part
7. Raised heel with appropriate mechanical resonance
8. Water proof and light
9. Color appropriate
10. Inexpensive
11. Deformities accommodating



# Anti-Fall Shoes

## Characteristics

- Fitting
- Light weight
- Antislippery
- Enhance proprioception
- Fashionable



Supported by Industrial Bureau of Hong Kong Government



# Hip Protector - Our Design

- Anthropometric design
- Materials – Cushions and Garment
- Effectiveness
- Compliance



- HK PolyU - Rehabilitation Engineering Centre
- HK PolyU - Institute of Textile and Clothing

# Conclusion

## *Fragility Fractures*

- ◆ **Major challenges**
  - ◆ Large patient volume (increasing!!)
  - ◆ Surgical and Medical complexities
  - ◆ Medico-social/economical issues
- ◆ **Multidisciplinary collaborations**
  - ◆ Ortho-geriatrician
  - ◆ Geri-anaesthetist
  - ◆ Rehabilitation and social service
- ◆ **Improving surgical techniques**
  - ◆ Healing of osteoporotic fractures
  - ◆ Augmentation of fixations
  - ◆ New technology
- ◆ **Prevention programs**
  - ◆ Primary prevention program
  - ◆ Secondary prevention program

# We need to work together.....

- ◆ Gerontologists
- ◆ Orthopaedic Surgeons
- ◆ Bio-Engineers
- ◆ Injury prevention
- ◆ Psychologists
- ◆ Rehabilitation specialists
- ◆ Social Workers

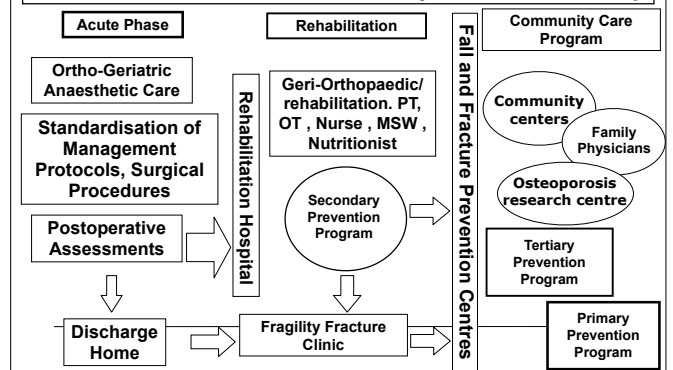


**Multidisciplinary Partnerships**



# Comprehensive Care for Elderly with Fragility Fractures

*Seamless Holistic Care from Hospital to Community*



## Why Orthopaedic Surgeons?

- Our immediate responsibility to treat the fractures
  - Team leader in clinical care
  - Take care of the consequences of falls
  - We have the first hand information
- We understand and share most what our patients and their families suffer from Falls
- To perform related research projects

**It is our responsibility to lead the program and extend it to all social strata!**

## Thank you!



### Acknowledgements:

- ◆ SK Yee Medical Foundation
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- ◆ Elderly Services, Tung Wah Group of Hospitals
- ◆ Orthopaedic nurses PWH
- ◆ Volunteers - AADO Nurse Chapter

