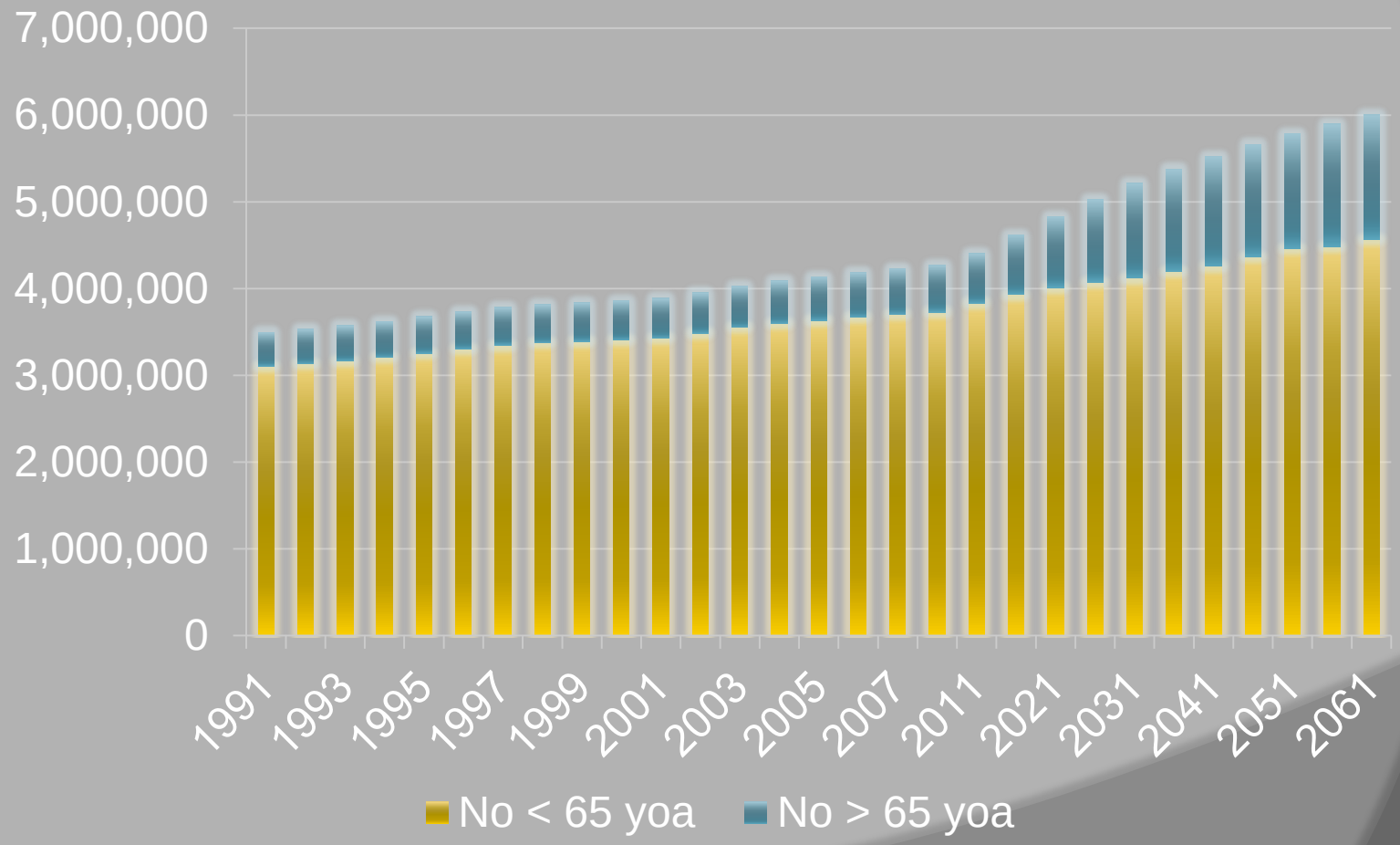
Osteoporotic fractures

Jean-Claude Theis

GP CME Meeting
Dunedin
18-19 August 2012

- Epidemiology
- BMD measurement
- Clinical assessment of fracture risk
- Management of osteoporosis
- Examples

Historical and projected general population figures



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Hip fractures: a deadly and silent epidemic

Jean-Claude Theis

Each year, about 3–4,000 hip fractures occur in New Zealand,[1] and the death rate (over 12 months) worldwide following hip fracture injury has been reported at between 20% and 35%.[2-4]

In New Zealand, very little published data on mortality and morbidity following neck of femur fractures exists to date. In this issue of the *Journal*, the article by William Young et al (*Audit of morbidity and mortality following neck of femur fracture using the POSSUM scoring system*. URL: http://www.nzma.org.nz/journal/119-1234/1986) is very timely as it highlights this life-changing and sometimes life-ending event amongst elderly New Zealanders.

A report by the New Zealand Health Information Service,[1] analysing hospital discharge data for the 1999/2000 period, showed an alarming mortality rate of 27% within 1 year following a neck of femur fracture. With an expected number of deaths of around 10%, the actual hip fracture related mortality was 17%.

With a rapidly ageing New Zealand population, the burden caused by hip fractures on the healthcare system is increasing rapidly. Sixteen percent of the population is currently aged over 60, but by 2050 this will double to just over 30%.[5] The biggest increase will be in the 85-and-over age group. As this group contributes almost exclusively to this fracture type, we can therefore expect an epidemic of hip fractures over the next 50 years in New Zealand.

The incidence of neck of femur fractures has increased in the last decade by 40% in men and 50% in women according to in a study carried out in New South Wales, Australia.[6] This trend is likely to continue in the future.

Young et al look at the value of a clinical severity score (POSSUM)[7] in assessing mortality and morbidity following hip fractures over a period of 6 months. They report a morbidity of 58% in these elderly patients on the basis of age and comorbidities. The mortality was 12% at 30 days and 32% at 1 year (six-fold increase over predicted mortality).

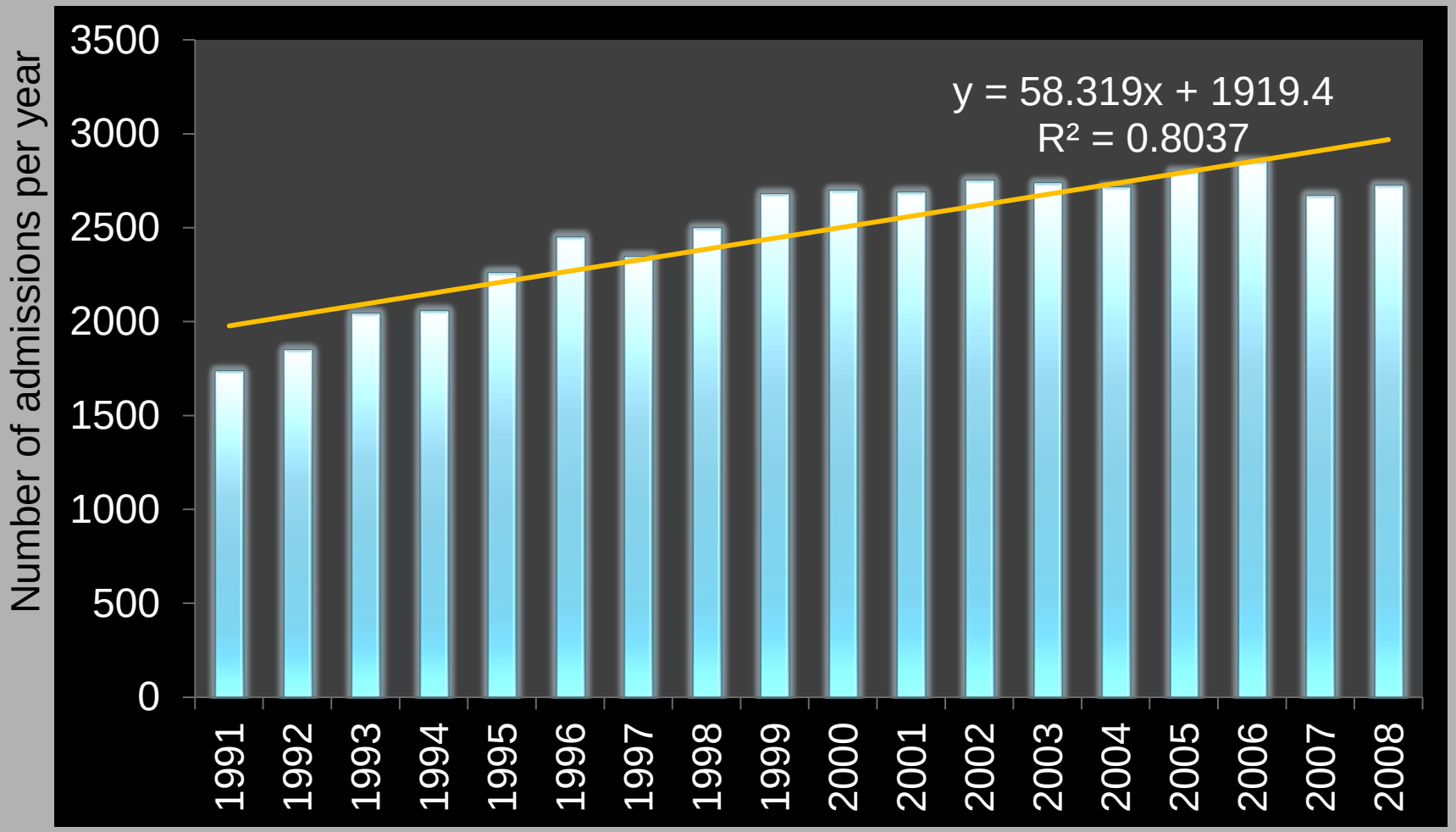
The POSSUM system sorts patients into risk categories which is useful for comparing hip fracture mortality between hospitals. Unfortunately this scoring system cannot be used as a preoperative predictor of postoperative outcomes in individual patients, however.

A medical condition with such high mortality and morbidity (affecting the very frail of our community in a rapidly rising manner) must deserve more attention from our healthcare system. The causes of hip fracture mortality are well known and include age, severity of comorbid conditions, mental status, and delay in time to surgery. The only factor which we can really influence is the time to surgery.

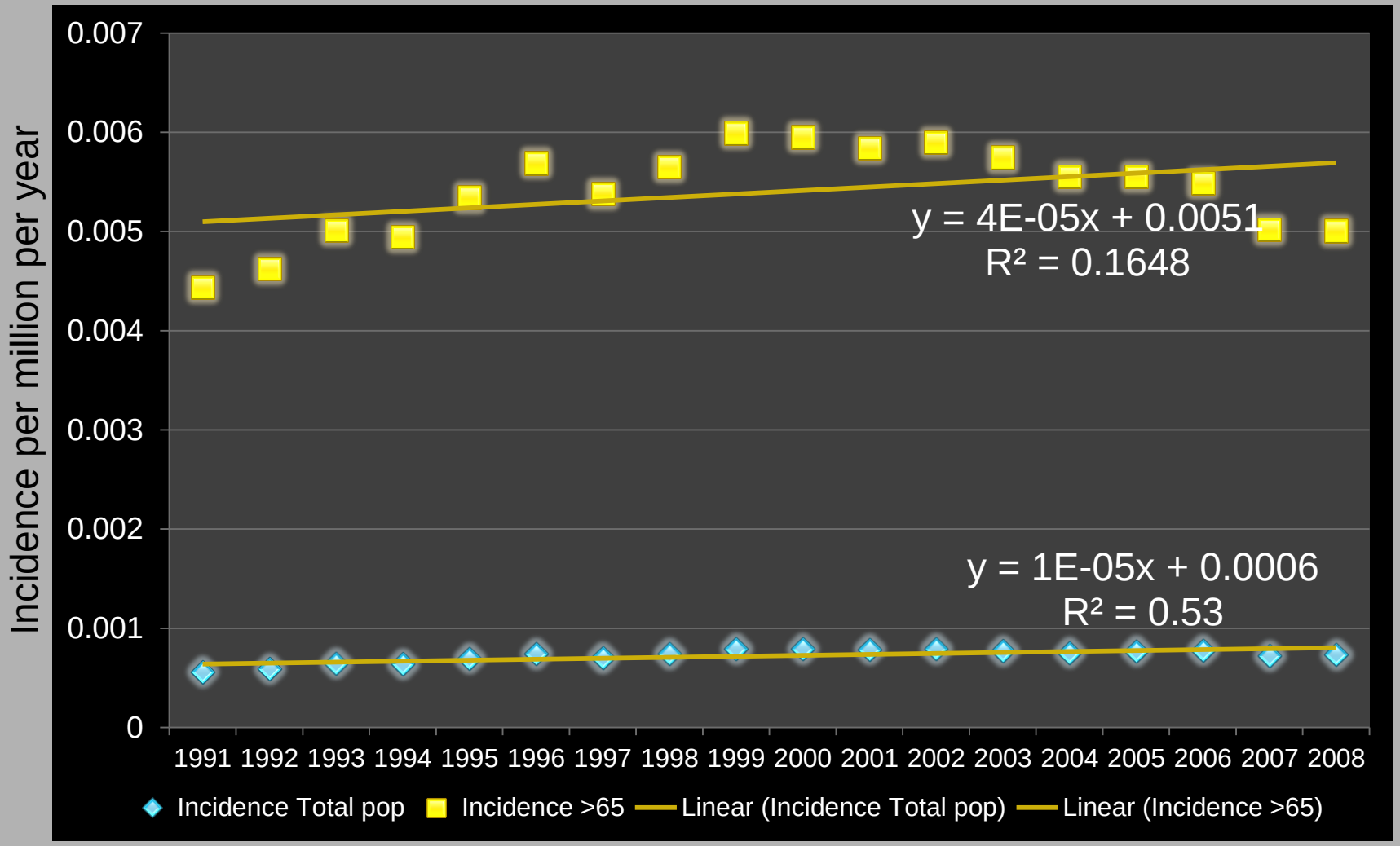
A recent multicentre study in the United Kingdom[8] reported that 40% of procedures were performed more than 24 hours after admission. Delay was associated with an

NOF fractures

Number of NOF fractures per year over time



Incidence of fractures per year over time



Data obtained on 48,670 #NOF

Variable	Median	25/75 centile
Age (years) at #	82.7	77/87
% died at follow-up	71%	
Duration of survival (years)	3.35	0.925/7.29
Age at OP who died	83.6*	78.4/88.1
Age at OP survivors	79.2*	70.9/85.0
ICISS score	1.11	1.02/1.27
ICISS score who died	1.13*	1.02/1.30
ICISS score survivors	1.08*	1.02/1.20

*Unless otherwise stated, all contrasting figures in gold have a $p<0.0001$

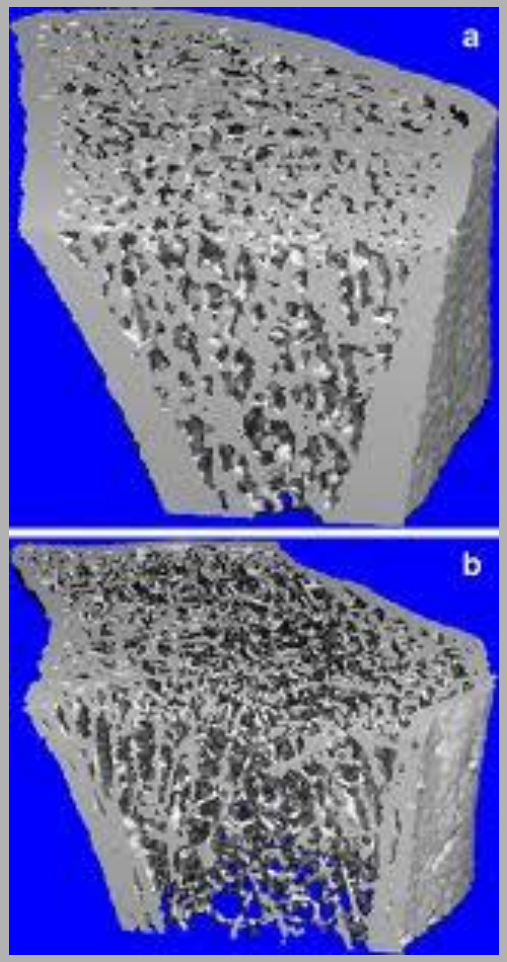
- Incidence >65 age group: 5 per 1000
- Incidence risen by 0.2 per 1000 in general population (absolute number 2x)
- Over the last 20 years
  - Older (average 4 years)
  - Sicker (25% rise in comorbidity score)
  - More likely to die (1.5% rise in mortality)

- Survival:
  - Median 3 years 4 months
  - 25% mortality 1 year
  - 55% mortality 5 years
  - Men worse than women
- Comorbidities:
  - Increase in ICISS score by 0.03

Recommendations

- National Hip Fracture Strategy
- National Osteoporosis and Falls Prevention Programmes
- Access to acute theatre within 24 hours
- Multidisciplinary Hip Fracture Teams
- Geriatric and Rehabilitation Resources
- Primary Care and Community support

- Osteoporosis=age related bone failure
- Low bone mass and micro architectural weakness
- Fragility fractures spine, hip, wrist, humerus etc
- Low energy trauma
- 9 million osteoporotic fractures/year worldwide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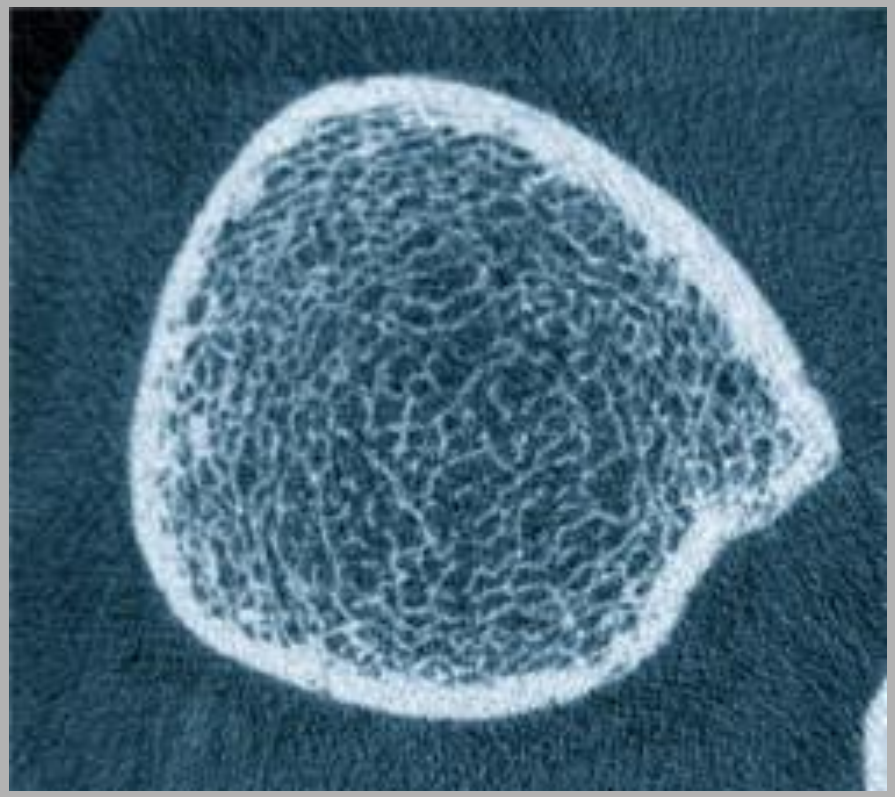

Bone strength

- Bone mineral content (Dexa scan)
- Geometry (Xrays)
- Microarchitecture (microCT, bone biopsy)
- Bone turnover (Te bone scan)

Fracture risk increases with decreasing BMD

Other factors

- Age
- Previous fracture
- Glucocorticoids
- Family history
- Smoking/alcohol

Assessment of fracture risk

- WHO 1994
- Standard deviation difference (SD) between a patient's BMD and that of a young adult reference population =T score
- T score equal or less than -2.5 = osteoporosis
- T score between -1.0 and -2.5 = osteopenia
- T score -1.0 or higher = normal

- Highest fracture risk in osteoporosis group
- Most fractures in the osteopenia group

- Clinical risk factors independent of BMD have been shown to be most predictive of fracture

Fracture risk

- Absolute risk (AR)
- Relative risk (RR)= ratio of AR of 2 populations

- In clinical practice preferred fracture risk assessment=AR over 10 years

FRAX tool

- WHO 2008
- 10 year probability of hip and other osteoporotic fractures between the ages of 40 and 90 years using BMD and clinical risk
- Large prospective observational studies to validate FRAX
- Country specific
- FRAX calculator

New Zealand - The probabilities of a major osteoporotic fracture in women

The following tables give the 10-year probability (%) of a major osteoporotic fracture (hip, clinical spine, forearm or proximal humerus fracture) according to the T-score for femoral neck BMD , the number of clinical risk factors (CRF) and age. Each table provides a mean estimate and a range, based on the epidemiology of New Zealand. The range is not a confidence interval, but because the weight of different risk factors varies, is a true range.

Note that the BMI is set at 24 kg/m².

Age = 50 years

Number of CRFs	BMD T-score (femoral neck)										
	-4.0	-3.5	-3.0	-2.5	-2.0	-1.5	-1.0	-0.5	0	0.5	1.0
0	9.8	6.2	4.1	3.0	2.3	1.9	1.6	1.4	1.4	1.3	1.3
1	15 (13-19)	9.6 (8.4-12)	6.4 (5.4-8.1)	4.6 (3.6-5.8)	3.5 (2.6-4.4)	2.9 (2.0-3.7)	2.4 (1.6-3.2)	2.2 (1.4-3.0)	2.1 (1.3-2.9)	2.0 (1.3-2.7)	1.9 (1.2-2.6)
2	23 (17-32)	14 (11-21)	9.7 (7.3-14)	6.9 (4.8-9.9)	5.3 (3.3-8.1)	4.3 (2.5-6.9)	3.6 (2.0-6.0)	3.2 (1.7-5.5)	3.0 (1.6-5.3)	2.9 (1.5-5.1)	2.8 (1.4-4.9)
3	33 (23-45)	21 (15-29)	14 (10-21)	10 (6.5-16)	7.8 (4.5-13)	6.3 (3.3-11)	5.2 (2.6-9.7)	4.7 (2.2-8.9)	4.4 (2.1-8.5)	4.2 (1.9-8.2)	4.1 (1.8-7.9)
4	46 (32-58)	31 (21-39)	21 (14-27)	15 (9.8-21)	11 (7.4-17)	9.0 (5.5-14)	7.5 (4.3-12)	6.8 (3.7-11)	6.4 (3.4-11)	6.1 (3.1-10)	5.8 (3.0-10)
5	60 (50-70)	43 (34-49)	30 (23-33)	21 (16-25)	16 (12-20)	13 (9.7-17)	11 (8.1-15)	9.5 (6.9-13)	9.0 (6.3-13)	8.5 (5.8-12)	8.2 (5.5-12)
6	75	57	41	30	22	18	15	13	12	12	11

Methods of BMD Measurement

- Dual-energy x-ray absorptiometry (DEXA)
- Peripheral DEXA (pDEXA)
- Quantitative ultrasonography (QUS)
- Quantitative computed tomography (QCT)
- Others
  - Micro CT, micro MRI
  - Structural engineering models (SEM's)
  - Finite element analysis (FEA)

DEXA

- Dual-energy x-ray absorptiometry (DEXA)
  - Bone mineral content (grams)
  - Bone area (square cms)
  - Areal BMD (g/cm2)
- Skeletal sites:
  - Hip
  - Lumbar spine
  - Forearm
- Disadvantages:
  - Machine not portable
  - Low dose radiation

Prodigy Patients - [116B_etkj4d7wh.dff]

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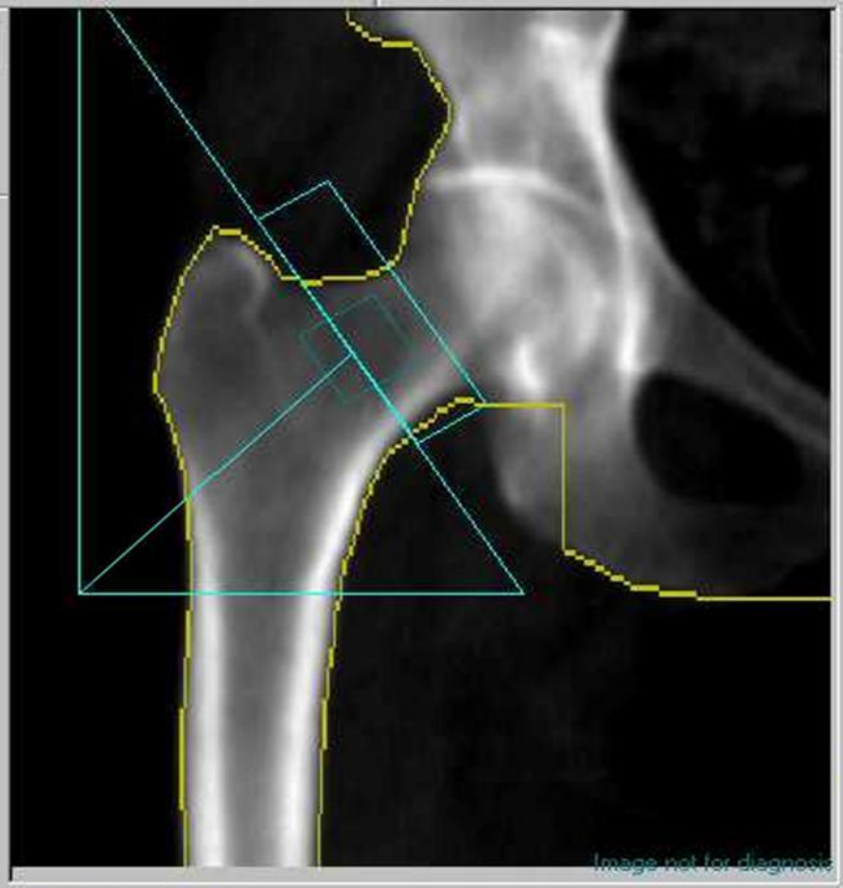
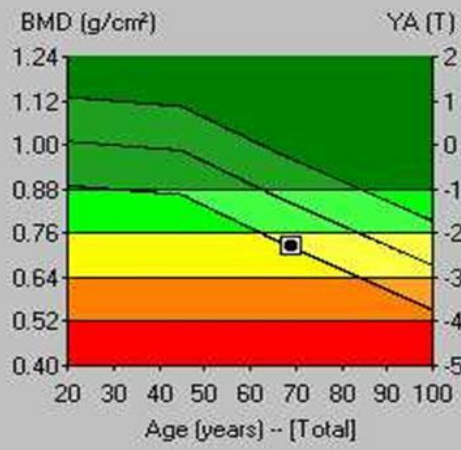
Measure Analyze Directory QA Imaging ROIs Points Compare Print Save Close



Densitometry | Reference | Trend | Information



Region	BMD (g/cm²)	YA (T)	AM (Z)
Neck	0.615	-3.0	-1.5
Wards	0.459	-3.5	-1.3
Troch	0.552	-2.2	-1.3
Shaft	0.926	-	-
Total	0.725	-2.3	-1.0

Standard Results
Select region: up/down arrows
Change results tab: left/right arrows

116, BLO
Born 12/10/1928 61.0 in. 120.0 lbs. White Female
51

Peripheral DEXA

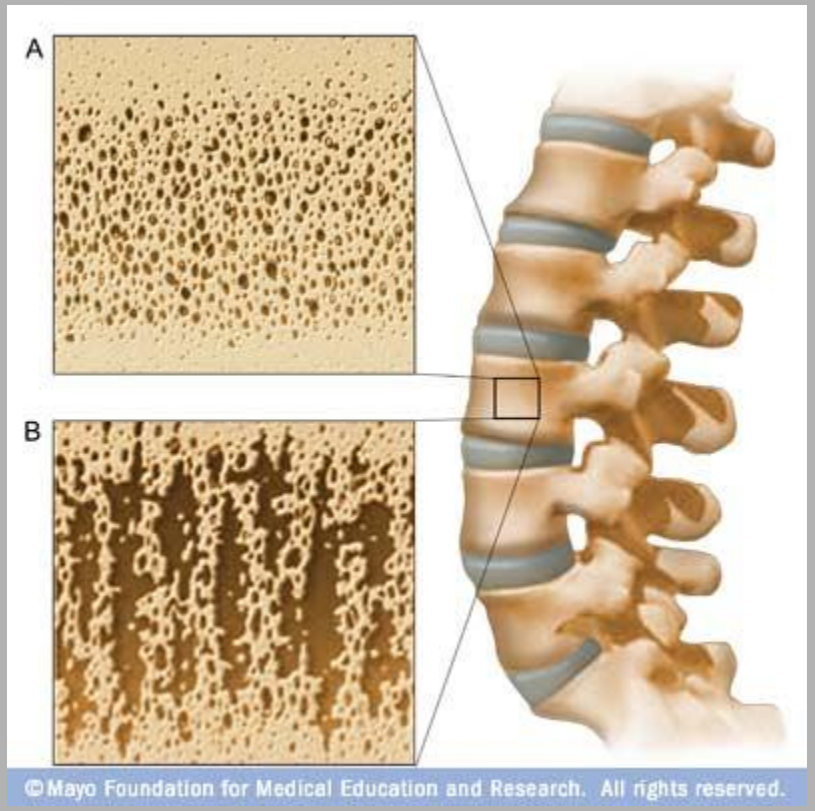
- Portable machine
- DEXA measurement at peripheral sites: forearm , calcaneus, and finger
- Lack of standardised reference databases for calculating T score
- Can’t be used for diagnostic classification
- Not useful for monitoring therapy

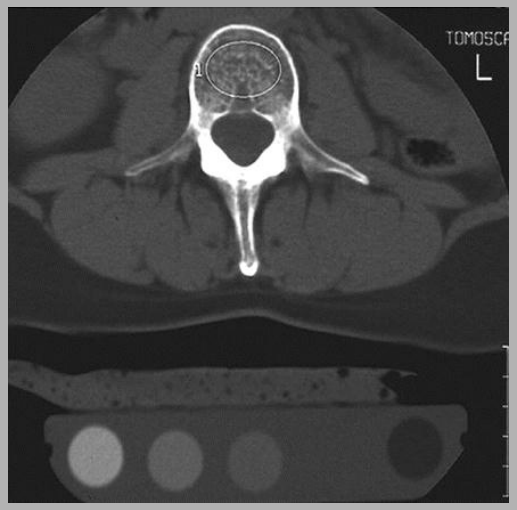
Quantitative US

- Does not measure bone density but transmission of ultrasound through bone
- Peripheral sites mainly heel
- Broadband ultrasound attenuation (BUA), speed of sound (SOS), quantitative ultrasound index (QUI) or stiffness index(SI)
- Advantages cost, portable and no radiation exposure
- Good predictor of osteoporotic risk fracture

Quantitative CT

- Measures volumetric BMD mg/cm3
- Can isolate trabecular bone from cortical bone
- Spine mainly
- Better predictor of vertebral fractures than DEXA
- More expensive and higher radiation
- QCT is primarily a research tool





Management of a patient with an osteoporotic fracture

- Measure BMD using DEXA
- Assess other risk factors
- Estimate the risk of further fractures using FRAX

- Aim is to prevent further fractures
  - Management of osteoporosis
  - Prevention of falls

Treatment of osteoporosis

- Indications:
  - Vertebral # with a T score of -1
  - Other fractures with a T score of -2
- Biphosphonates
- Other modalities:
  - Smoking cessation
  - WB exercises
  - Adequate Ca and Vit D intake (1000 mg Ca, 400-800 IU vit D)
- Repeat BMD after 2 years

Ca vitamin D supplements

- Vit D and Calcium
- Murray Tilyard paper NEJM 1992
  - Treatment of postmenopausal osteoporosis with calcitriol or calcium
  - RCT 622 women with osteoporosis
  - 0.25 microg vit D3 versus 1 g Calcium
  - FU 3 years
  - Ca group 20% new vertebral #'s
  - Vit D3 group 5.6% new vertebral #'s (mod 3.6%, sev 13%)

Vit D / Ca effectiveness?

- Literature ambiguous
- Hip versus vertebral fractures
- No difference in hip # risk with high or low dose vit D supplementation compared to controls (systematic review)
- Hip fracture patients often have low vit D levels
- Other papers report a decrease in hip fractures by combining vit D and Ca supplementation

Biphosphonates

- Alendronate (10 mg/day) reduces hip and spine fractures by 50%

Surgical issues

- Fracture healing is normal in osteoporosis
- Age and comorbidities
- Mortality (NOF #)
- Fracture fixation challenging
  - Poor bone quality
  - Special locking plates
  - Often additional external support required
- Rehabilitation difficult
- Outcomes poor

Prevention of falls

- J Campbell et al BMJ 2007
- Training balance and increasing muscle strength reduces falls in the elderly
- Falls prevention programmes to increase muscle strength, flexibility, balance, coordination, reaction time, gait etc
- Reduce other fall risk factors

Summary

- Number of osteoporotic fractures increasing
- BMD best measured by DEXA scan
- Assessment of fracture risk (FRAX tool using BMD and other clinical factors)
- Prevent future fractures by fall prevention and bone sparing therapy
- Biphosphonates increase BMD but have to demonstrate a decrease in fracture rates
- GP has crucial role in osteoporosis management

Examples


HORIZONTAL RAY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C
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ANDERSON, PATRICIA, RUTH,
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25/09/1956
POST REDUCTION
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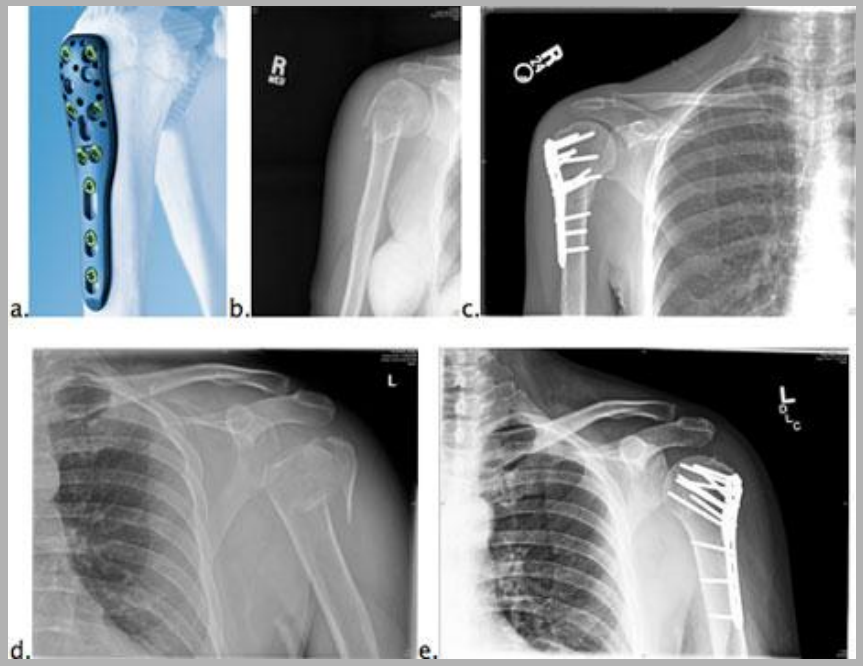
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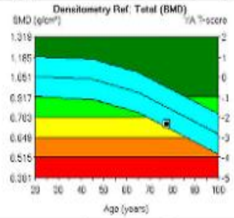
MCLAREN, ELIZABETH
CGQ3209
Total Body
January 10, 2012
Astonish Application
ANTERIOR
10/01/12 13:16:00
POSTERIOR
10/01/12 13:16:00
ANTERIOR
10/01/12 13:16:00
POSTERIOR

Dunedin Hospital

Patient:	MCLAREN, ELIZABETH MARGARET	**Patient ID:**	CGQ3209
Birth Date:	7/10/1934 77.7 years	**Referring Physician:**	THEIS, J / NEYLON, M
Height / Weight:	156.3 cm 58.5 kg	**Measured:**	20/06/2012 14:35:38 (13.60)
Sex / Ethnic:	Female White	**Analyzed:**	20/06/2012 14:37:52 (13.60)

Right Femur Bone Density



Region	BMD[1] (g/cm²)	Young-Adult[2] (%)	T-score	Age-Matched[3] (%)	Z-score
Neck	0.720	71	-2.3	93	-0.4
Wards	0.493	53	-2.9	81	-0.8
Troch	0.639	76	-1.6	91	-0.5
Shaft	0.020	-	-	-	-
Total	0.736	70	-2.4	87	-0.8

COMMENTS:

Image not for diagnosis
Printed: 20/06/2012 14:38:58 [illegible]
16.6 %Fat=25.5%
0.00 0.00 [illegible]
Neck Angle (deg)= 57
Filename: [illegible]
Scan Mode: Thin 5.0 µGy

1 - Statistically 68% of repeat scans fall within 1SD (± [illegible] g/cm² for Right Femur Total)
2 - Australia (Combined Geelong/Lunar) (ages 20-40) Femur Reference Population (v112)
3 - Matched for Age, Ethnic

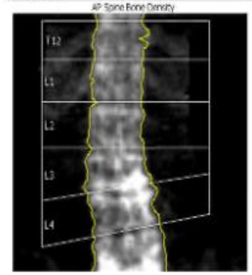
GE Healthcare

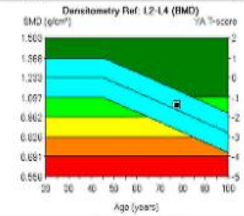
Lunar DPX
[illegible]

Dunedin Hospital

Patient:	MCLAREN, ELIZABETH MARGARET	**Patient ID:**	CGQ3209
Birth Date:	7/10/1934 77.7 years	**Referring Physician:**	THEIS, J / NEYLON, M
Height / Weight:	156.3 cm 58.5 kg	**Measured:**	20/06/2012 14:30:34 (13.60)
Sex / Ethnic:	Female White	**Analyzed:**	20/06/2012 14:38:21 (13.60)

AP Spine Bone Density





Region	BMD[1] (g/cm²)	Young-Adult[2] (%)	T-score	Age-Matched[3] (%)	Z-score
L1	0.787	71	-2.4	90	-0.7
L2	0.880	72	-2.4	90	-0.7
L3	1.134	90	-0.9	110	0.8
L4	1.102	90	-0.8	105	0.4
L1-L4	0.987	82	-1.7	101	0.1
L2-L4	1.042	85	-1.4	103	0.2

COMMENTS:

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1 - Statistically 68% of repeat scans fall within 1SD (± [illegible] g/cm² for AP Spine L2-L4)
2 - Australia (Combined Geelong/Lunar) (ages 20-40) AP Spine Reference Population (v112)
3 - Matched for Age, Ethnic

GE Healthcare

Lunar DPX
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