Roma, 8-11 novembre 2018

ITALIAN CHAPTER

Double X-ray Absorptiometry (DXA): clinical usefulness and pitfalls

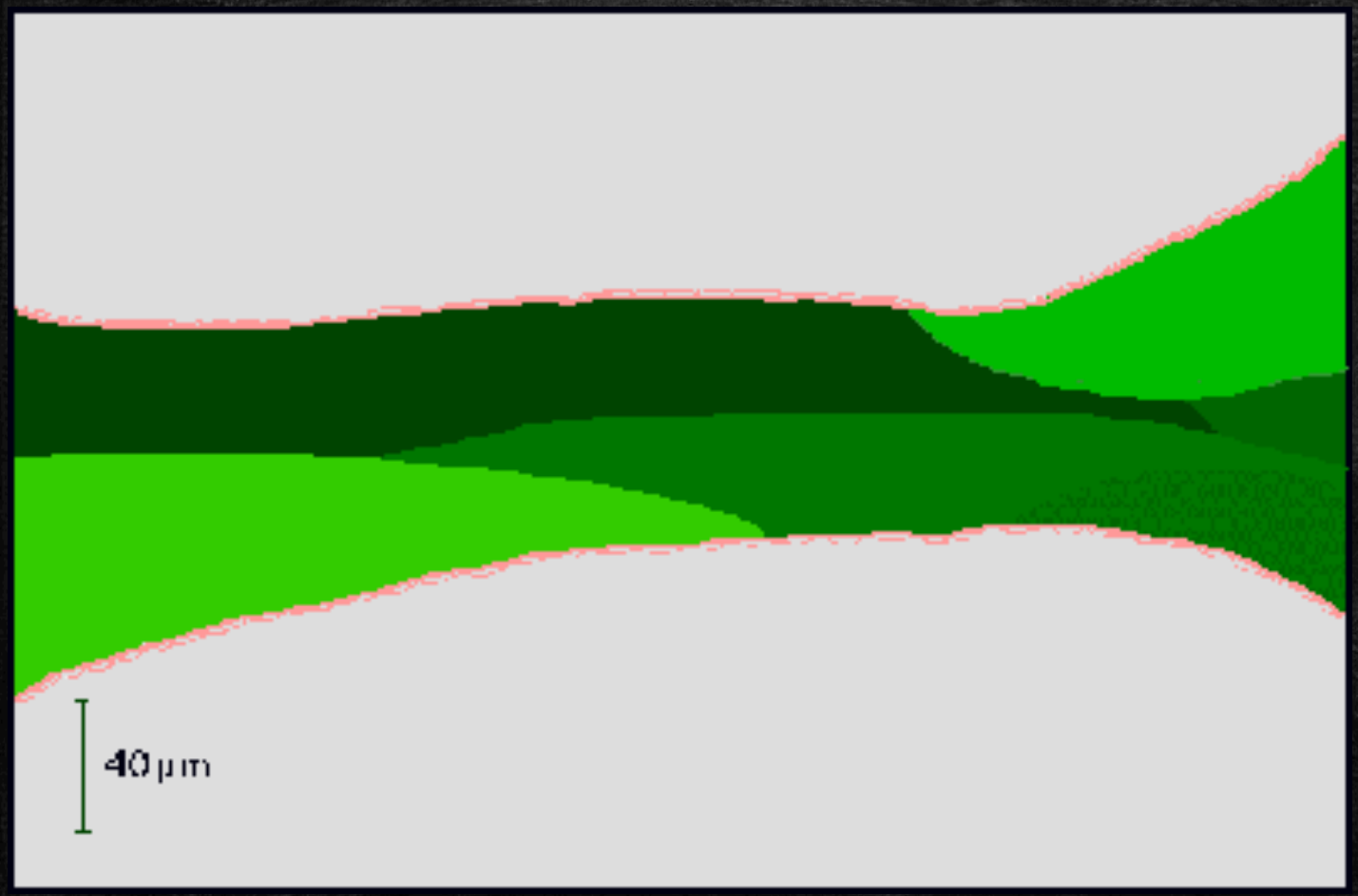
STEFANIA BONADONNA

CENTRO CLINICO E DI RICERCA
DI MALATTIE METABOLICHE DELL'OSSO
E DIABETOLOGIA

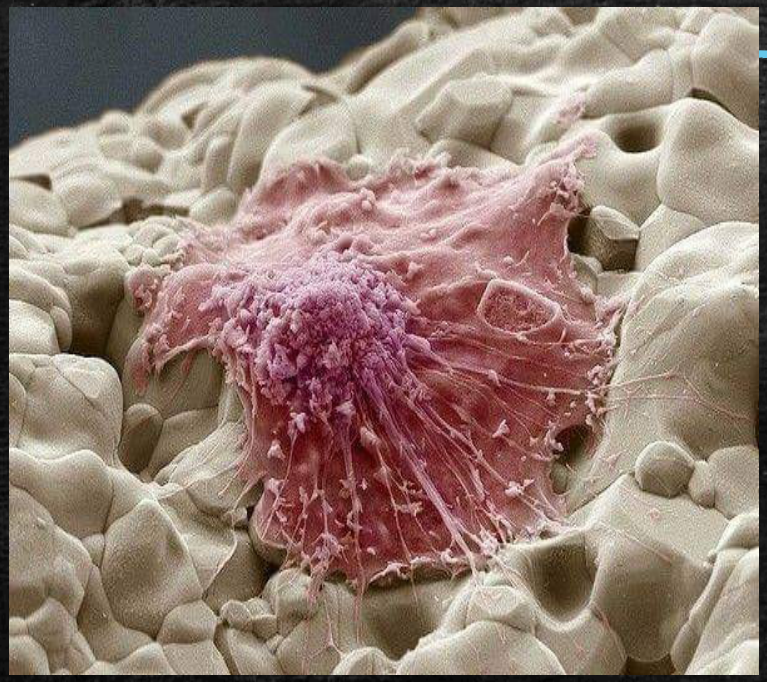
ISTITUTO AUXOLOGICO ITALIANO
Istituto di Ricovero e Cura a Carattere Scientifico

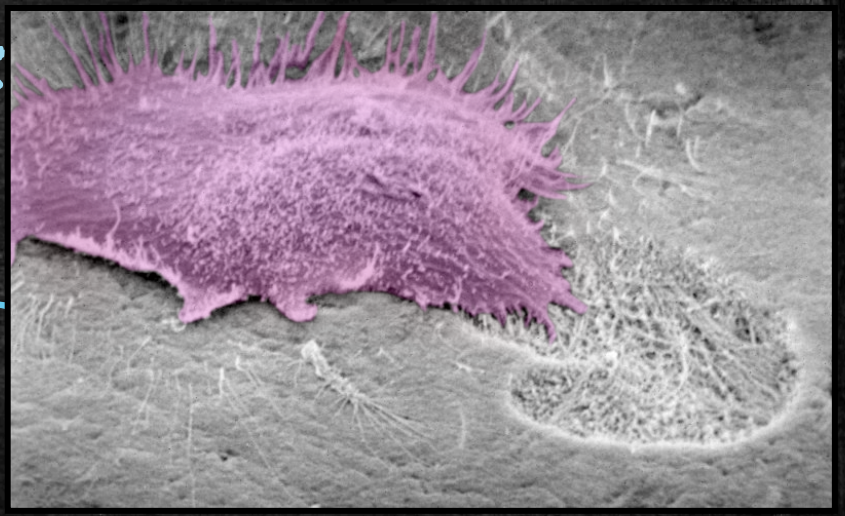
ONCE UPON A TIME...

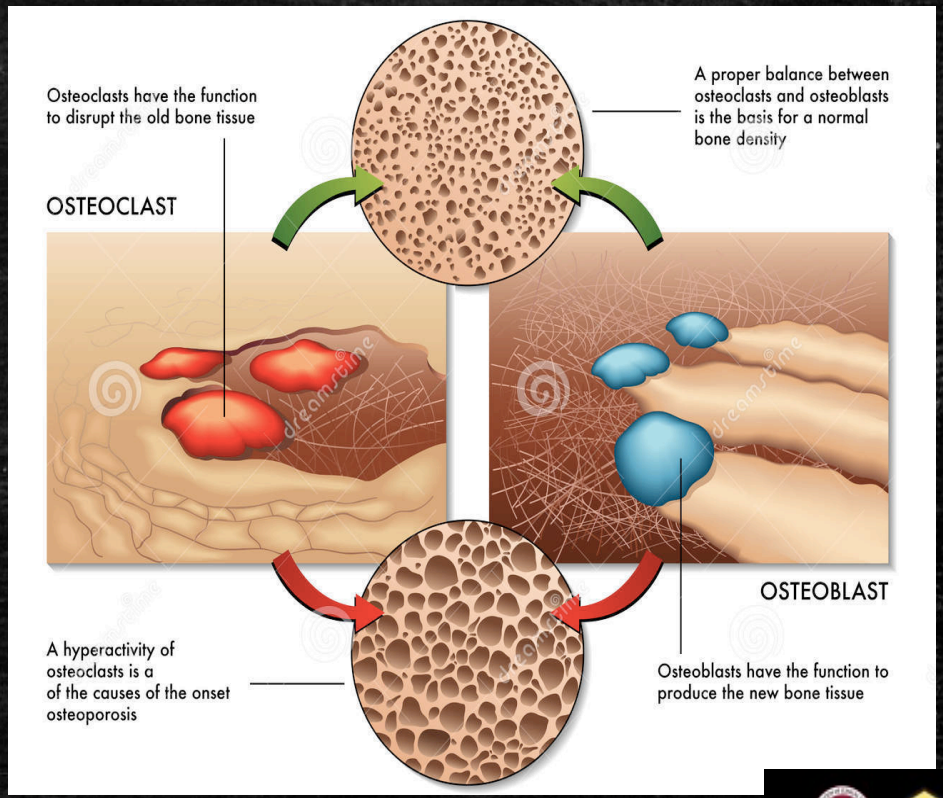
BONE REMODELLING -THE KEY!



BONE REMODELLING: THE KEY







Adapted from: http://www.brsoc.org.uk/gallery/arnett_osteoclast.jpg.
Electron micrograph photo reproduced with permission.© Tim Arnett, The Bone Research Society.

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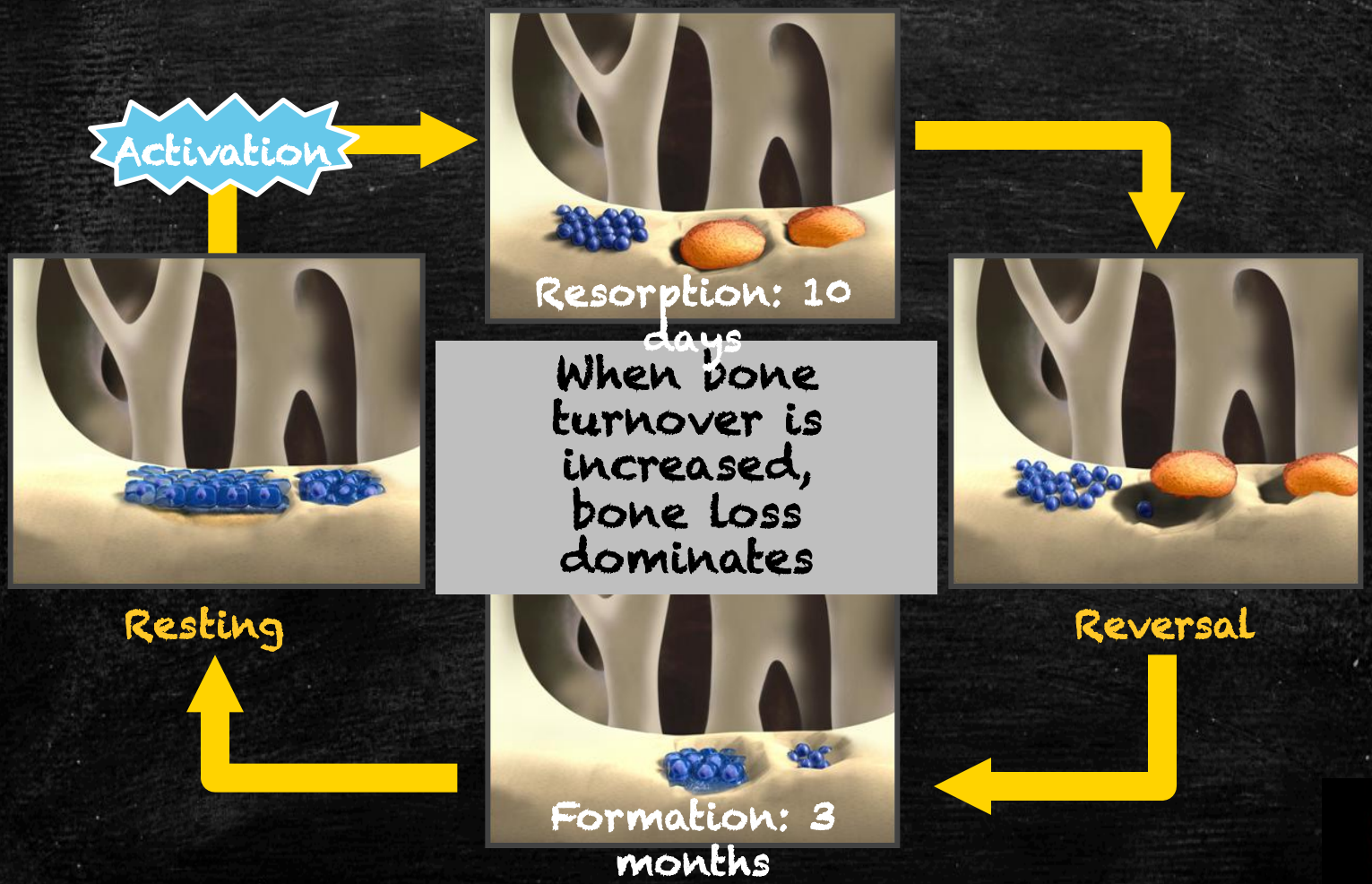
A HEALTHY SKELETON REQUIRES A BALANCE OF BONE RESORPTION AND BONE FORMATION



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OSTEOPOROSIS / OSTEOPENIA

OSTEO = BONE
POROUS = VOID SPACES
OSIS = CONDITION OF

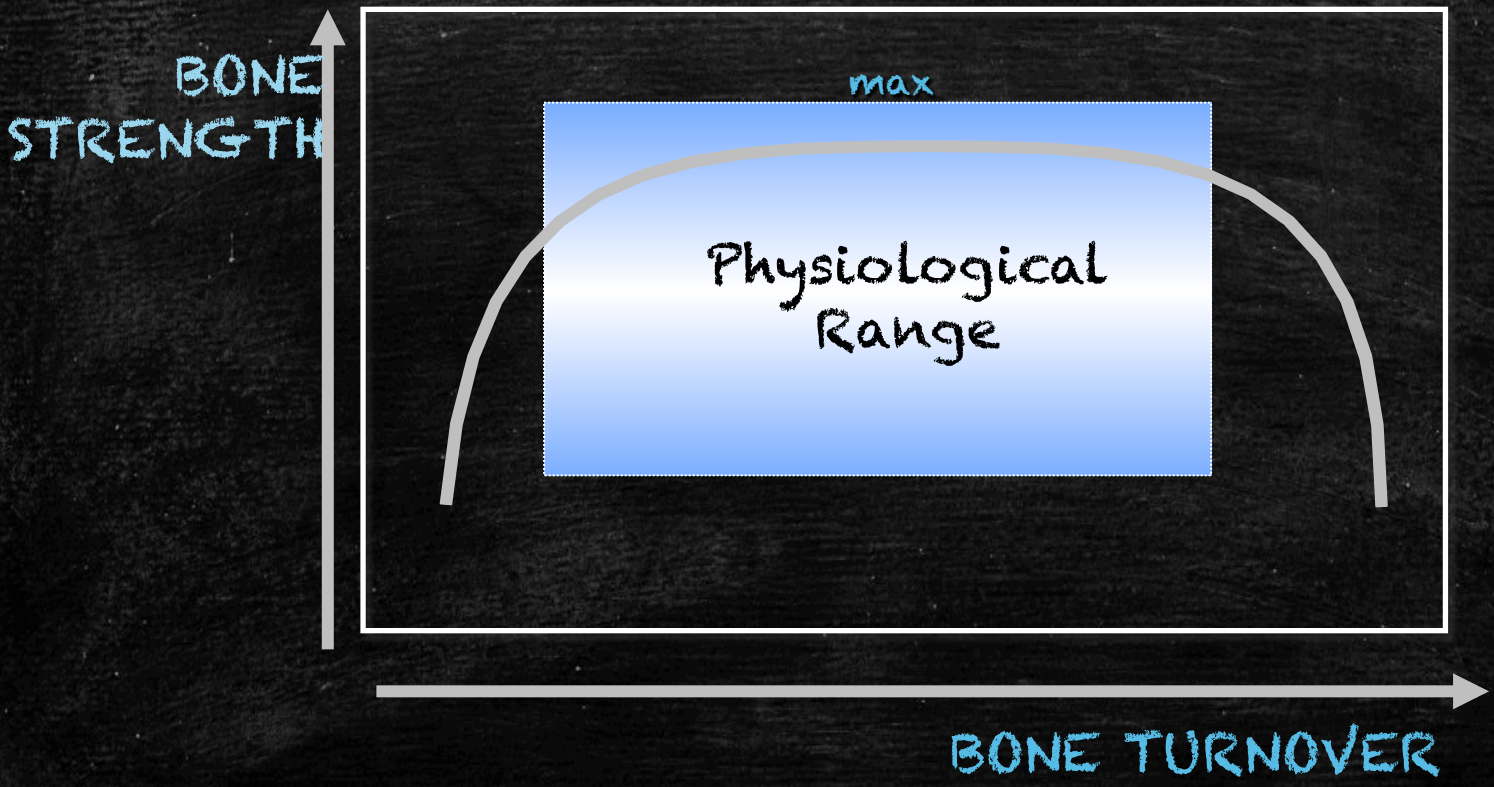
OSTEOPENIA = LOW BONE

ISCD recommend that reports should use the term **low bone mass** and not osteopenia

PHYSIOLOGICAL REMODELLING - BONE QUALITY

INSUFFICIENT TURNOVER
- Accumulation of microdamage
- Increased brittleness due to excessive mineralization

EXCESSIVE TURNOVER
- Increase in stress risers (weak zones)
- Increase in perforation
- Loss of connectivity



Adapted from Weinstein RS. J Bone Miner Res 15: 621, 2000

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EXCESSIVE REMODELLING CONTRIBUTES TO OSTEOPOROSIS

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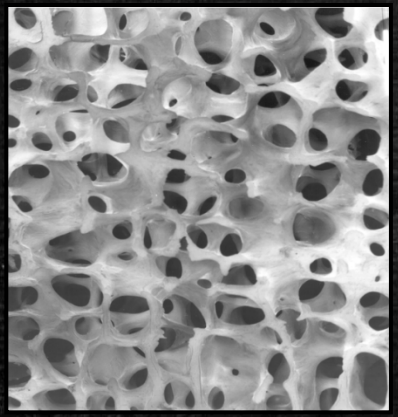
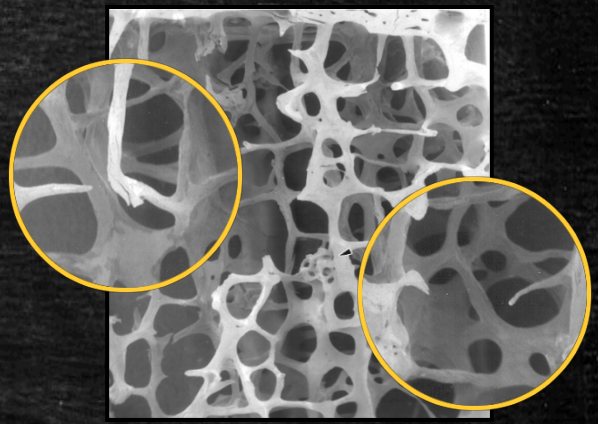
Normal Quantity and Architecture	Loss of Quantity	Loss of Quantity and Architecture





Increased bone remodelling → Structural deterioration → Increased skeletal fragility → Increased fracture risk

SCOPE OF THE PROBLEM

Osteoporosis is estimated to affect 200 million women worldwide - approximately:

one-tenth of women aged 60,
one-fifth of women aged 70,
two-fifths of women aged 80 and
two-thirds of women aged 90

Osteoporosis affects an estimated 75 million people in Europe, USA and Japan

OSTEOPOROSIS RELATED FRACTURES

A fracture that should have not happened:

- Metatarsal bones while dancing
- Fibula while walking
- Lumbar spine while lifting water
- Ribs while coughing...

Fragility fractures or low-trauma fractures occurring with minimal trauma - a force equal to or less than falling from standing height

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INCIDENCE OF OSTEOPOROTIC FRACTURE

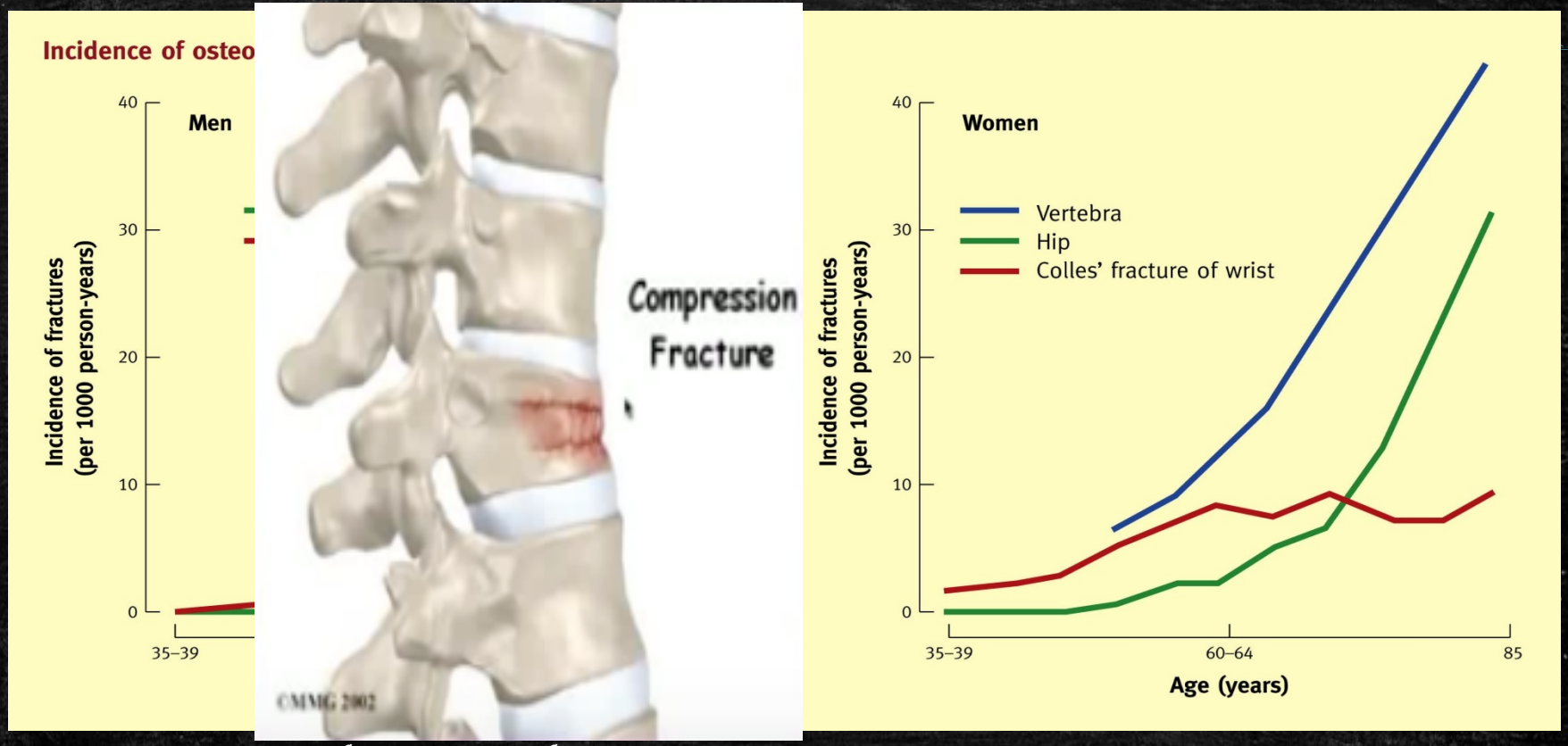

Figure 2 Incidence of osteoporotic fractures.

Richard Eastell
Identification and management of osteoporosis in older adults
Medicine Volume 41, Issue 1 2013 47 - 52

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HIP FRACTURE

By 2050, the worldwide incidence of hip fracture in men is projected to increase by 310% and 240% in women, compared to rates in 1990

Hip strength and flexibility protect against hip fracture

MORTALITY and DISABILITY

MORTALITY

- 5% immediately
- 25% in 1 year (as breast cancer)

DISABILITY

- 20% compromized functional status
- 50% reduction in mobility and related functions
- if invalid 20-25% hospedalization

Table 4

Cause of Death 1 Year After Proximal Femoral Fracture

Cause of Death	No. (%) Surgically Treated Patients (n=53)	No. (%) Nonsurgically Treated Patients (n=9)
Deterioration of preexisting comorbidities	10 (18.9)	6 (66.7)
Cerebrovascular disease	9 (17)	0 (0)
Aspiration pneumonia	11 (20.8)	2 (22.2)
Pneumonia	4 (7.5)	0 (0)
Malignancy	1 (1.9)	0 (0)
Insenescence	6 (11.3)	1 (11.1)
Sepsis	2 (3.8)	0 (0)
Acute myocardial infarction	2 (3.8)	0 (0)
Multiple organ failure	2 (3.8)	0 (0)
Pulmonary embolism	1 (1.9)	0 (0)
Unknown	5 (9.4)	0 (0)

Rosell PAE. Functional Outcome after Hip Fracture Injury, 2003

PREVIOUS NON-TRAUMATIC FRACTURES

Regardless of the bone density,

a previous non traumatic fracture

↓

predicts future fractures

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BONE DENSITY AND BONE QUALITY

- Bone density is a part of bone quality
- Bone quality extends beyond bone density
  - Sound nutrition: vit D-vit K-Mg-Ca...
  - Digestive health
  - Exercise
  - Collagen disorder + other disease or drugs affecting bone

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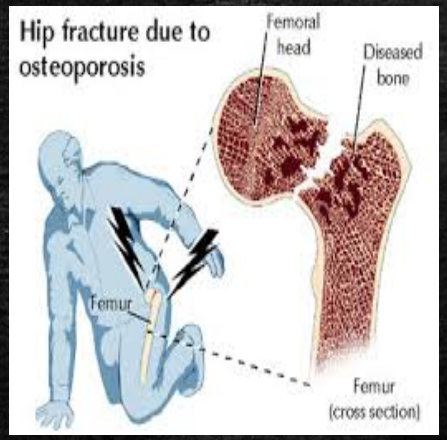
BONE DENSITOMETRY



osteporosis diagnosis

risk of fracture

effect of treatment

Who Should Have a Bone Density Test?

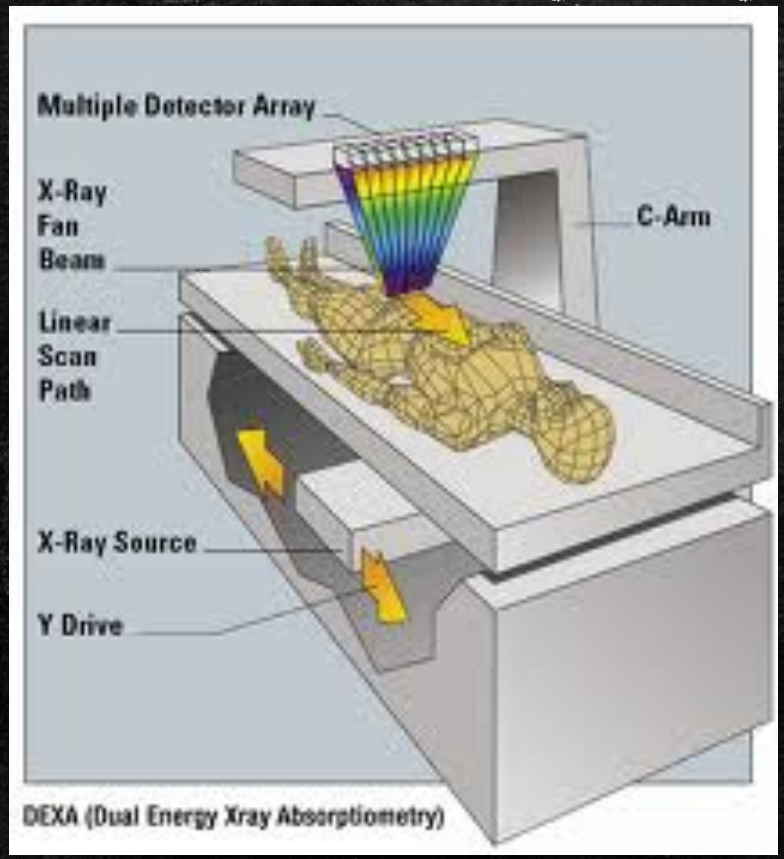
INDICATION

Women age 65 and older Men age 70 and older
Postmenopausal women and men (ages 50-69) with clinical risk factors
Adults who have a fragility fracture
Adults with a condition (e.g., rheumatoid arthritis) or taking a medication (e.g., glucocorticoids) associated with low bone mass or bone loss

BONE DENSITOMETRY

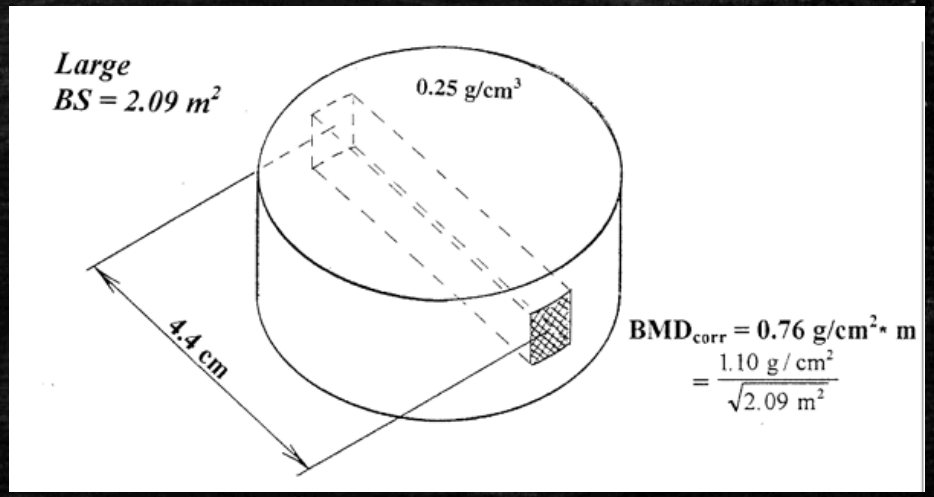
HOLOGIC LUNAR

DXA itself uses an X-ray tube to generate two energy X-ray beams of different energies: one "low-energy" X-ray beam of 40 keV and one "high-energy" X-ray beam >70 keV.

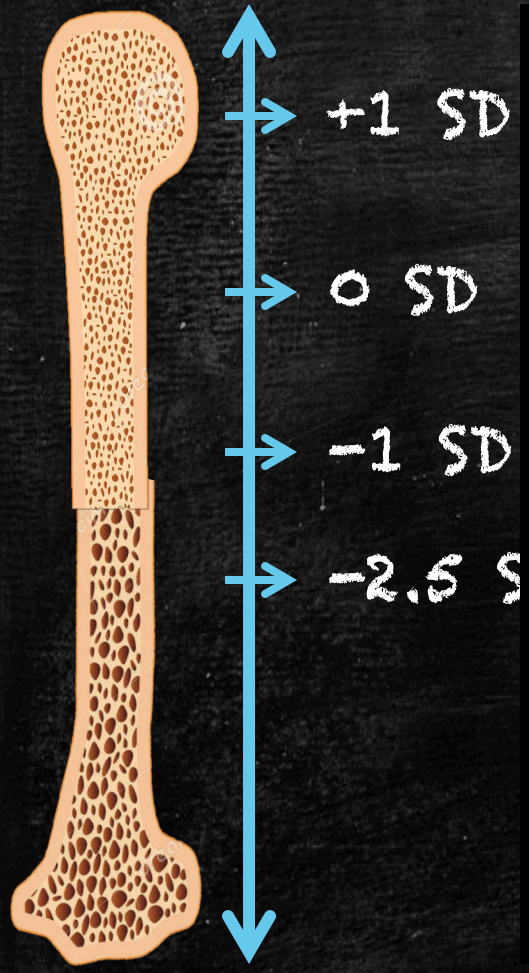


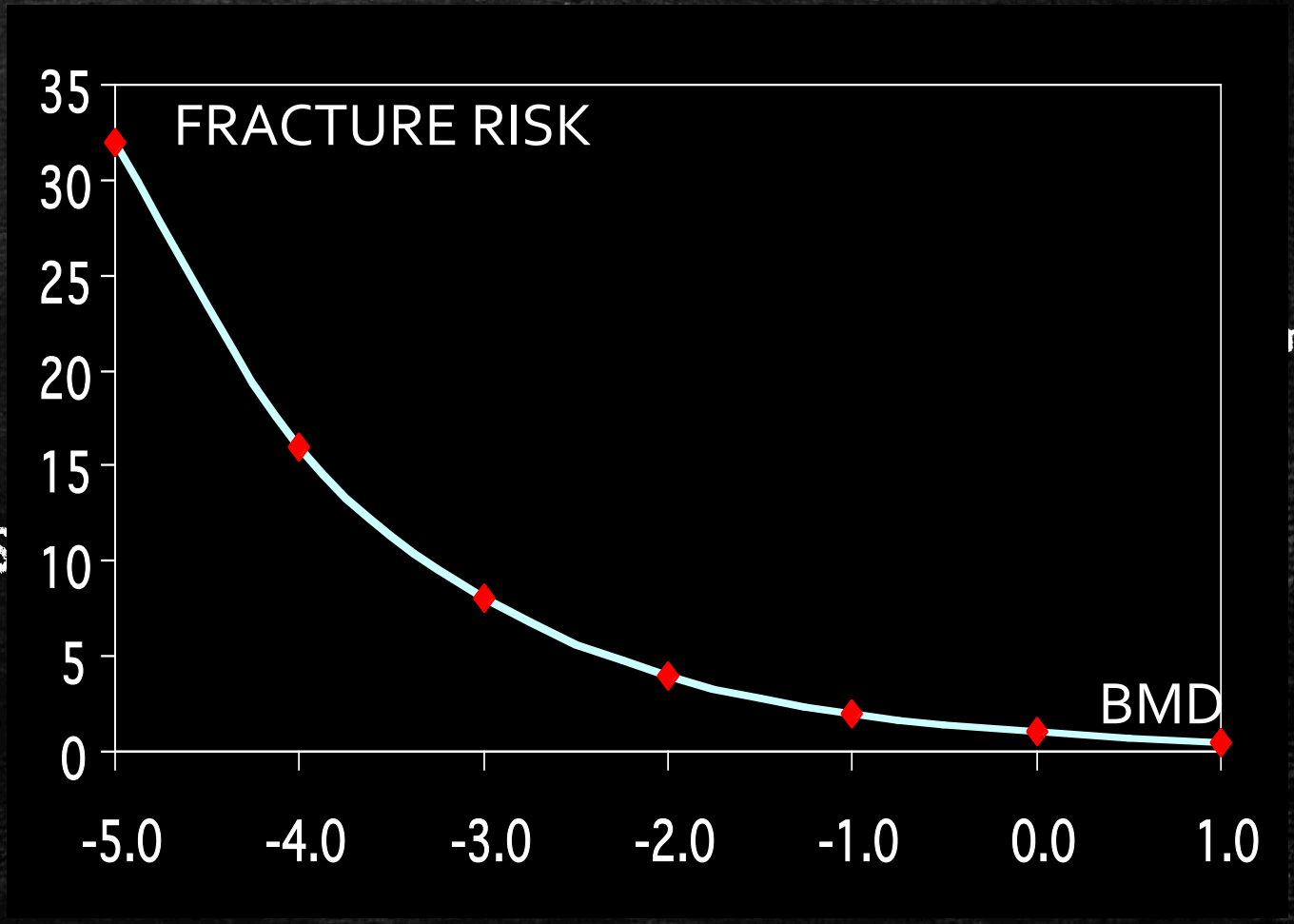
DEXA (Dual Energy Xray Absorptiometry)

two energy beams enables subtraction of the soft tissue component as they become attenuated differently and are recorded by a flexible detector arm



BONE MASS DEFINITION
ACCORDING TO WHO





Low bone mass is the single best predictor of future fracture risk

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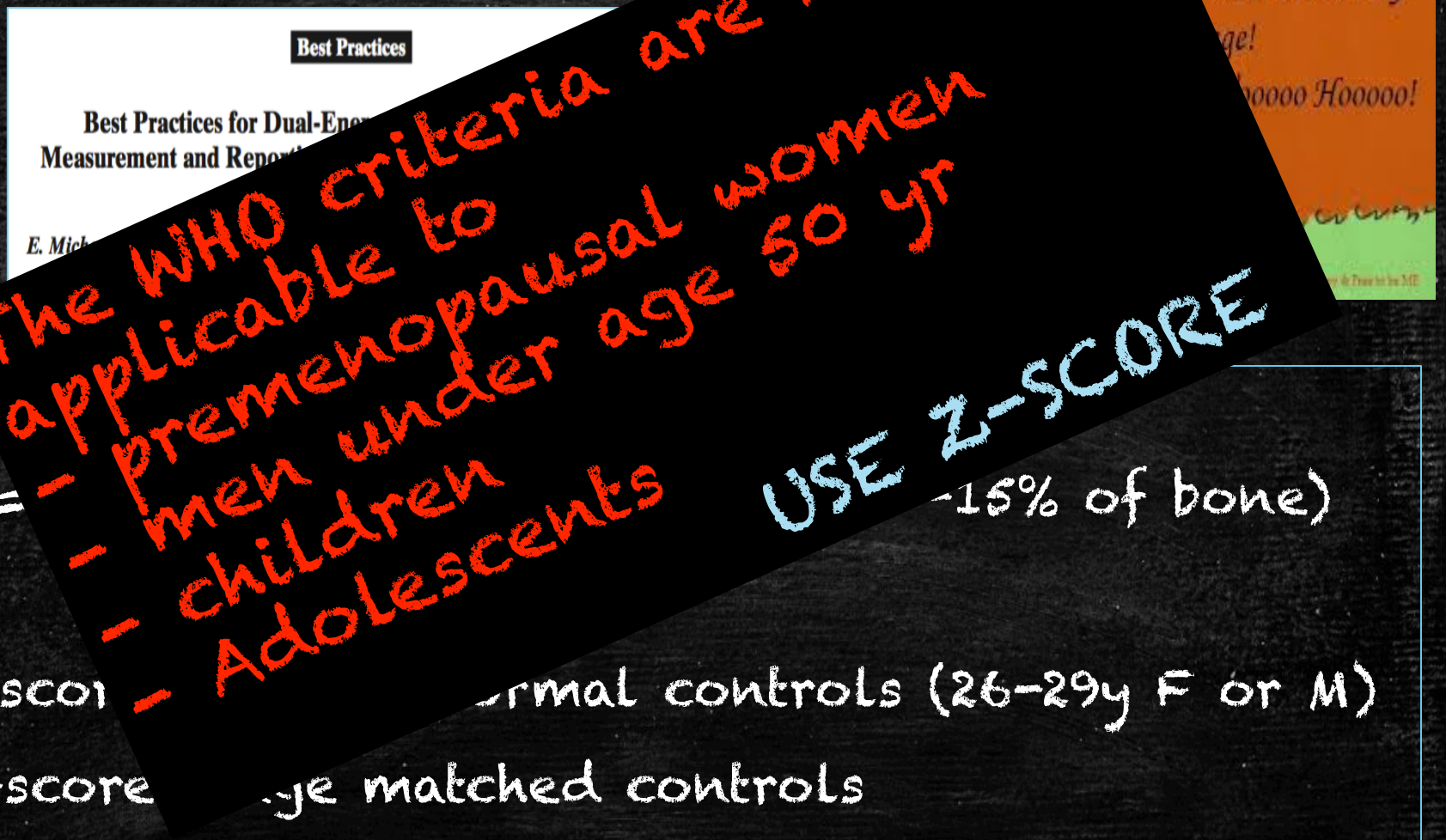
DEXA REPORTS



The WHO criteria are NOT
- applicable to
- premenopausal women
- men under age 50 yr
- children
- Adolescents

USE Z-SCORE

- BA
- SD= -15% of bone)
- T-sco rmal controls (26-29y F or M)
- Z-score ye matched controls

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DEXA REPORT - OSTEOPOROSIS DEFINITION

- Diagnosis of OP can be made if the T-score is -2.5 SD or lower in any of the following anatomical site:
  - Femoral Neck
  - Total Hip
  - Lumbar Spine - minimum of 2 vertebra
  - Forearm distal 1/3 site. Non dominant arm.

Best Practices

CrossMark

Best Practices for Dual-Energy X-ray Absorptiometry Measurement and Reporting: International Society for Clinical Densitometry Guidance

E. Michael Lewiecki,[*,1] *Neil Binkley,*[2] *Sarah L. Morgan,*[3] *Christopher R. Shuhart,*[4] *Bruno Muzzi Camargos,*[5] *John J. Carey,*[6] *Catherine M. Gordon,*[7] *Lawrence G. Jankowski,*[8] *Joon-Kiong Lee,*[9] *and William D. Leslie*[10] *on behalf of the International Society for Clinical Densitometry*

There Is a Single Diagnosis Reported for Each Patient, Not a Different Diagnosis for Each Skeletal Site Measured

Comment. The ISCD Official Positions state that osteoporosis may be diagnosed in postmenopausal women and in men aged 50 yr and older if the T-score of the lumbar spine, total proximal femur, femoral neck, or 33% radius is ≤–2.5,

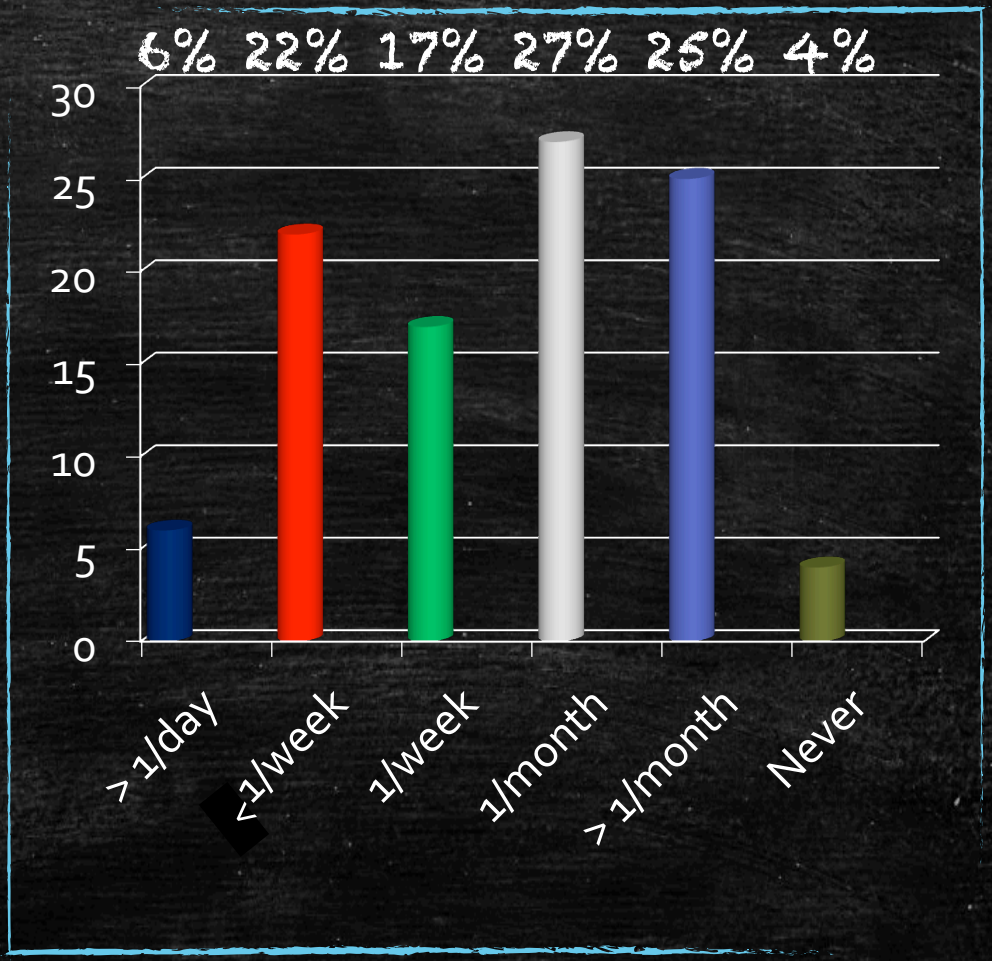
A SINGLE BONE DENSITY DOES NOT MEAN THAT BONE LOSS IS OCCURRING

Serial bone density comparison and lab test help to establish if bone is stable or if bone loss is occurring

MAY BE THEY NEVER GAINED A GOOD PEAK BONE MASS

DEXA ISCD HIGH RATE OF INCORRECT INTERPRETATION

HOW OFTEN DO YOU SEE A PATIENT WITH A DXA REPORT THAT IS INCORRECT?



Lewiecky em J clin endocrinol 2006

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.... IN THE BEGINNING...

DXA is the best first line and follow-up test?

Low radiation

Best if the facility has conducted a precision assessment, quantifying their least significant change (LCS). If they have done this, the LSC will be on the radiological report.

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DXA FACILITY

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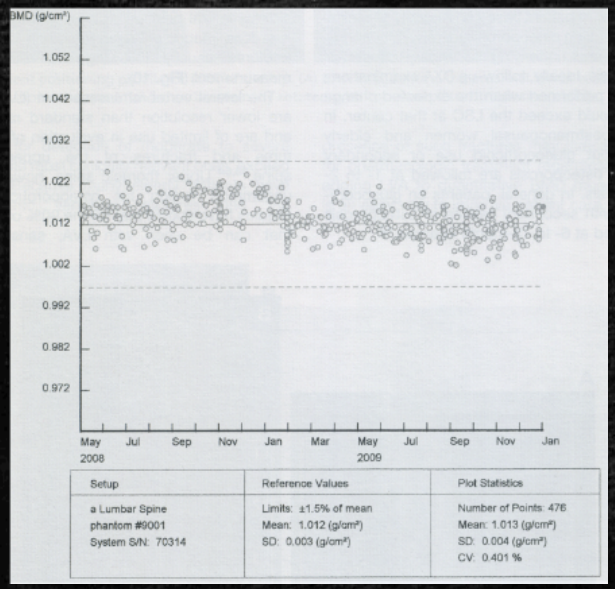
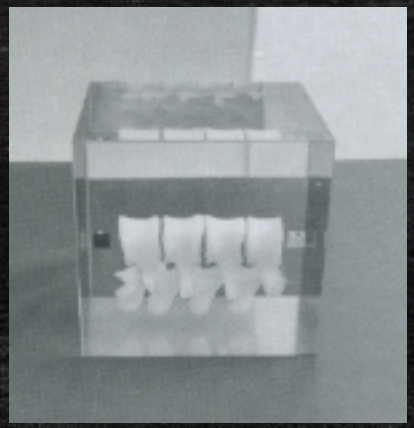
The quality control (QC) program at a DXA facility should include adherence to manufacturer guidelines for system mainteinance

- Perform periodic (at least once a week) phantom scans for any DXA system
- Plot and review data from calibration and phantom scans





- Each DXA facility should determine its precision error and calculate the LSC
- If more than 1 technologist an average precision error and LSC should be used

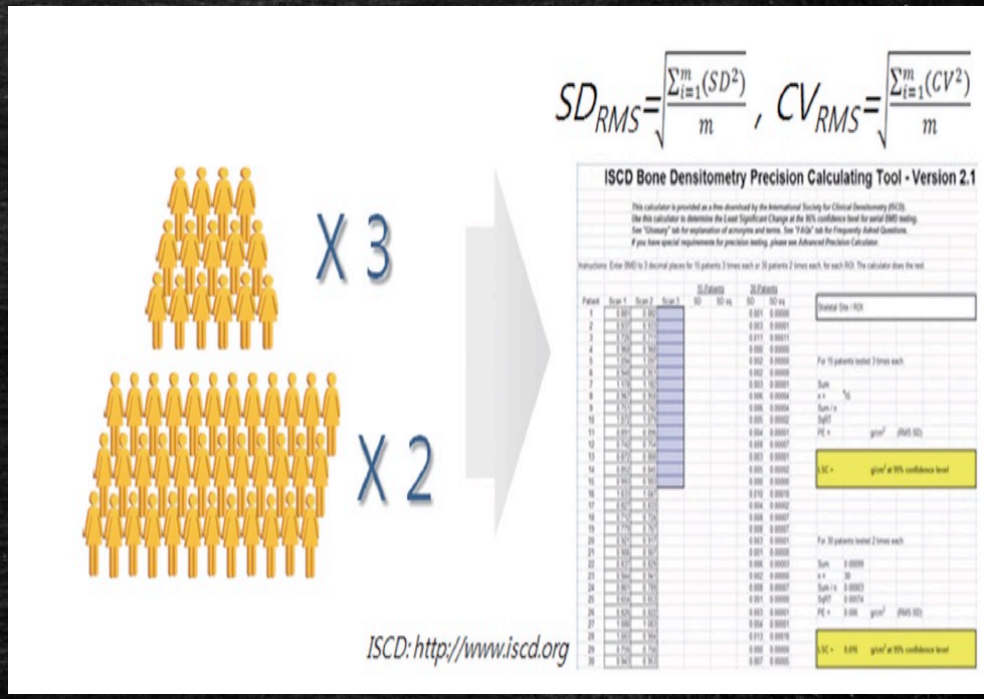
ISCD The International Society For Clinical Densitometry

ISCD Official Positions 2015

PRECISION ANALYSIS

To perform a precision analysis:

- Measure 15 patients 3 times, or 30 patients 2 times, repositioning the patient after each scan,
- Calculate the root mean square standard deviation for the group
- The ISCD and others have developed online calculators to facilitate this process



International Society for Clinical Densitometry. 2015 ISCD Calculators. Available at: http://www.iscd.org/resources/calculators/.

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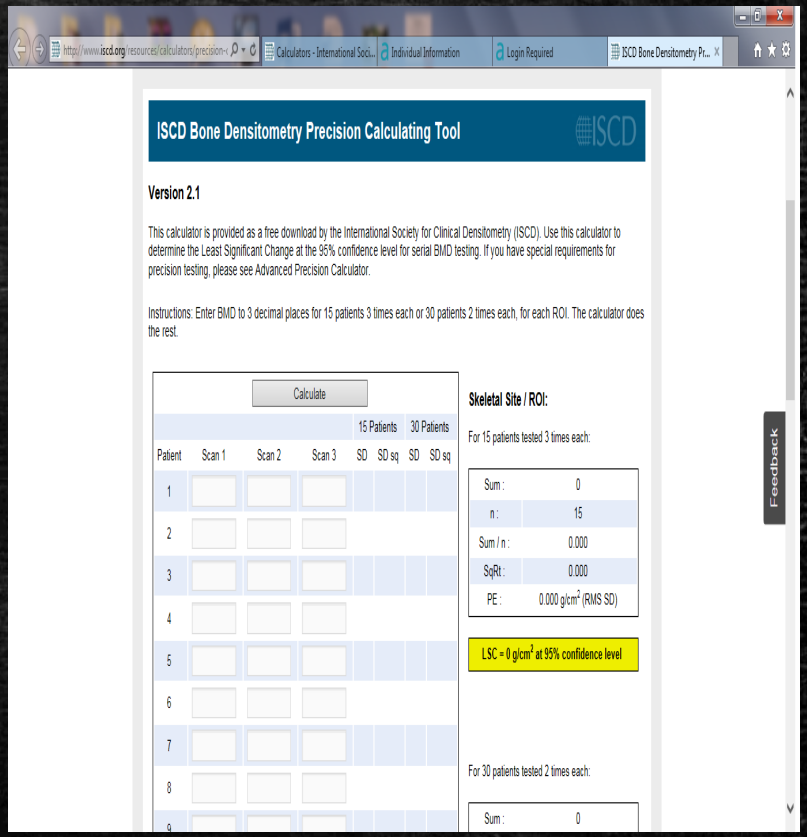
DETERMINATION OF LSC

- Calculate LSC for the group at 95% confidence interval.
- LSC is calculated by multiplying 2.77 to precision error
- The minimum acceptable precision for an individual technologist is:
- Lumbar spine: 1.9% (LSC = 5.3%),
- Total hip: 1.8% (LSC = 5.0%),
- Femoral neck: 2.5% (LSC= 6.9%),
- Retraining is required if a technologist's precision is worse than these values.



Shepherd JA, Schousboe JT, Broy SB, Engelke K, Leslie WD. Executive Summary of the 2015 ISCD Position Development Conference on Advanced Measures From DXA and QCT: Fracture Prediction Beyond BMD. J Clin Densitom. 2015 Jul-Sep;18(3):274-86

SERIAL BMD MEASUREMENTS

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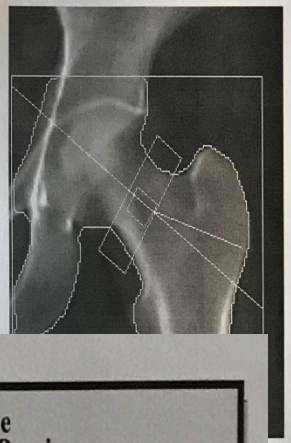
When reporting differences in BMD with serial measurements, only those changes that meet or exceed the Less Significant Change(LSC) are reported as a change.

ISTITUTO AUXOLOGICO ITALIANO IRCCS
Via Ariosto 13
20145 Milano
E-Mail: boneunit@auxologico.it Fax: 0261911.2429

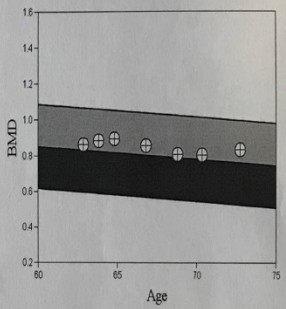
Patient ID: 08AX00003096
DOB: 02 February 1946
Sex: Female
Ethnicity: White
Menopause Age: 52
Height: 171.0 cm
Weight: 54.0 kg
Age: 72

Referring Physician: ORTOLANI



Scan Information:
Scan Date: 17 October 2018 ID: A10171817
Scan Type: a Left Hip
Analysis: 17 October 2018 12:59 Version 13.6.0.5
Left Hip
Operator: AI
Model: Horizon A (S/N 200654)
Comment:

Total



T-score vs. White Female. Source:HOLOGIC Z-score vs. White Female. Source:HOLOGIC

DXA Results Summary:

Scan Date	Age	BMD (g/cm²)	T-score	BMD Change vs Baseline	BMD Change vs Previous
17.10.2018	72	0.830	-1.2	-3.7%*	3.4%*
30.05.2016	70	0.802	-1.4	-6.9%*	-0.6%
22.11.2014	68	0.807	-1.4	-6.4%*	-5.5%*
28.11.2012	66	0.854	-1.0	-0.9%	-4.3%*
29.11.2010	64	0.892	-0.7	3.5%*	1.0%
30.11.2009	63	0.884	-0.8	2.5%	2.5%
16.12.2008	62	0.862	-0.9		

* Denotes significance at 95% confidence level, LSC is 0.027 g/cm²

T-score	BMD Change vs Baseline	BMD Change vs Previous
-1.2	-3.7%*	3.4%*
-1.4	-6.9%*	-0.6%
-1.4	-6.4%*	-5.5%*
-1.0	-0.9%	-4.3%*
-0.7	3.5%*	1.0%
-0.8	2.5%	2.5%
-0.9		

.027 g/cm²

DEXA: GOLD STANDARD?

YES AND NO!!!

The usefulness of DEXA depends on:

- The skill of the technician - patient set up and analysis of scans
- The radiologist's skill to oversee and correct the technician errors
- The clinician's efforts to analize computerized report carefully much like looking at x-rays

DXA

- Request hip and lumbar spine
- Return to the same exact machine if possible

ISCD Official Positions 2015

COMMON MISTAKES IN BMD TESTING.

- INDICATION
- QUALITY CONTROL
- ACQUISITION
- ANALYSIS
- INTERPRETATION

- Incorrect demographic information
- External artifacts
- Improper patient positioning
- Internal artifacts

Messina C, Bandirali M, Sconfienza LM, D'Alonzo NK, Di Leo G, Papini GD, Ulivieri FM, Sardanelli F. **Prevalence and type of errors in dual-energy x-ray absorptiometry.** Eur Radiol. 2015 May;25(5):1504-11.

DXA: LUMBAR SPINE

posteroanterior imaging of lumbar spine: supine with hips and knees flexed over support to reduce lordosis

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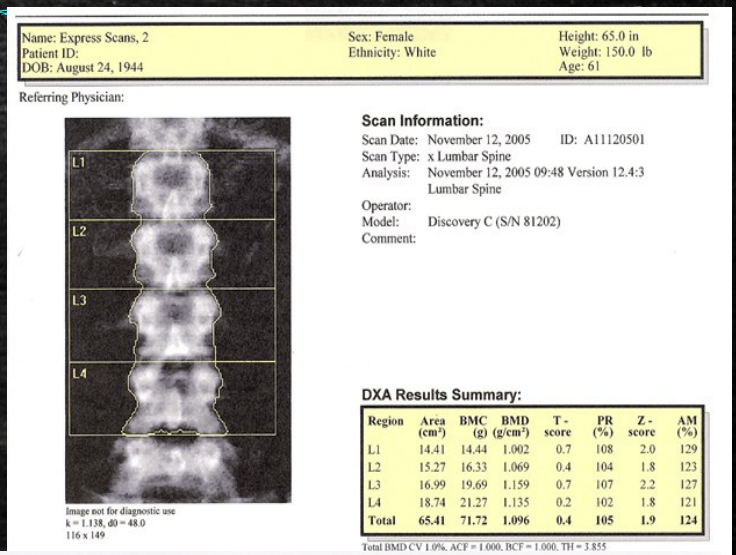
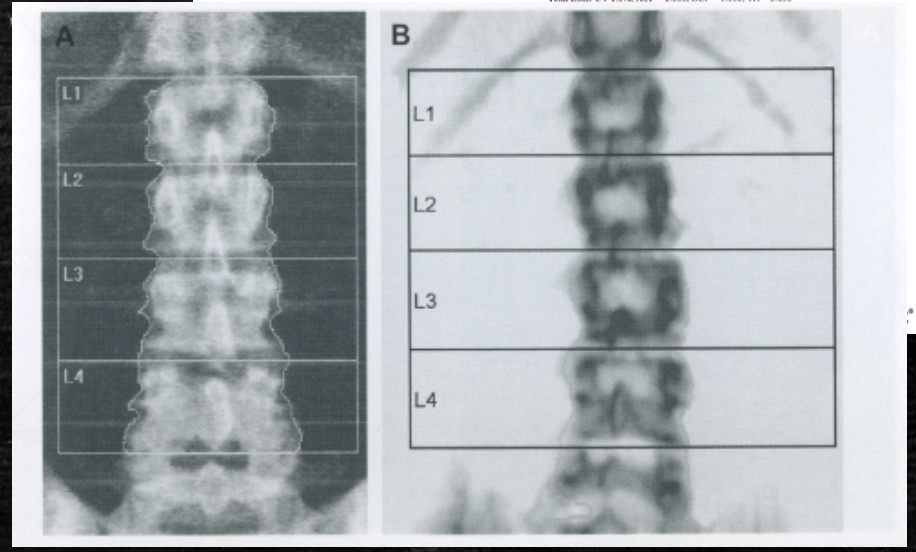
LUMBAR SPINE

Anatomic Regions of Interest (ROIs)

Numbering of vertebral bodies

- The ribs appear at T12
- The largest transverse processes are L3
- Vertebral area values increase from L1 to L4
- BMD increases from L1 to L3, and the BMD of L4 is similar to or slightly less than that of L3
- Helpful markers are the iliac crest, usually at the L4-L5 interspace, and lowest set of ribs, usually at T12

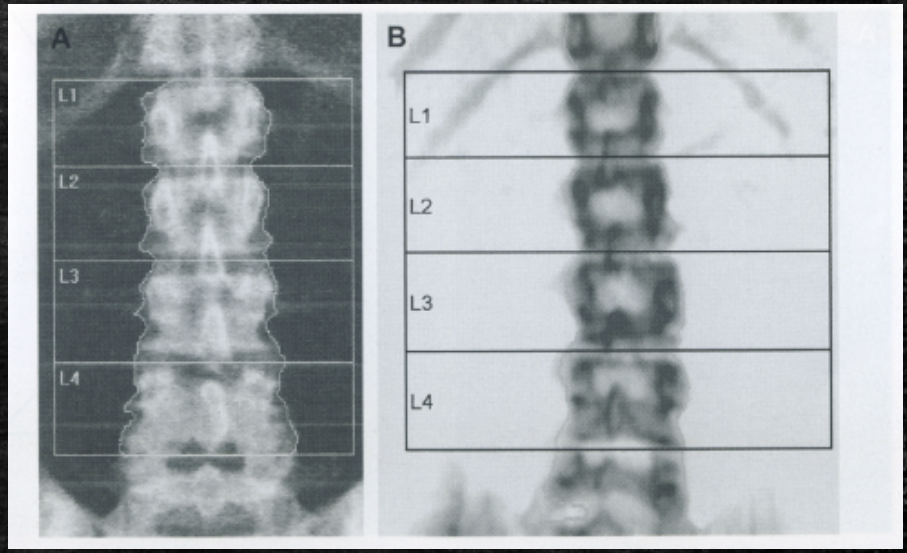




ISCD: numerical results - SPINE

- At least 2 vertebrae
- Do not report individual T-score
- Instead report T-score of L1-L4 if no excluded

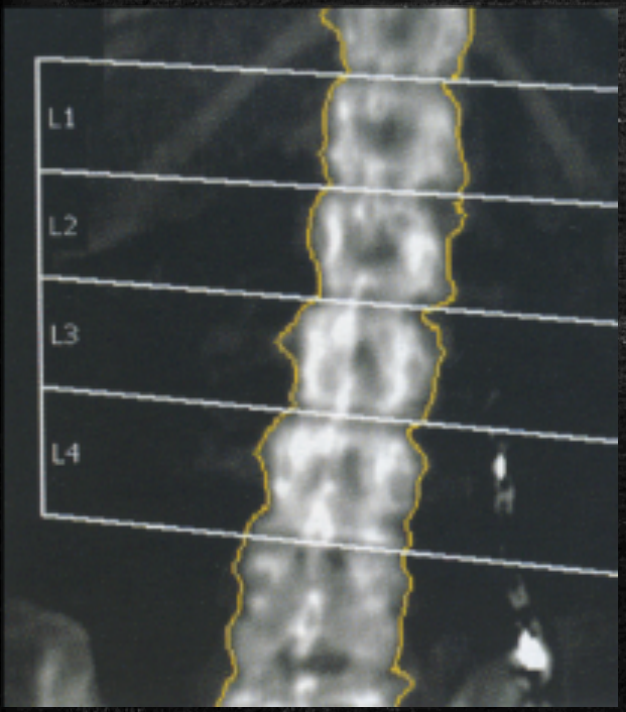
LUMBAR SPINE: OPTIMAL POSITIONING



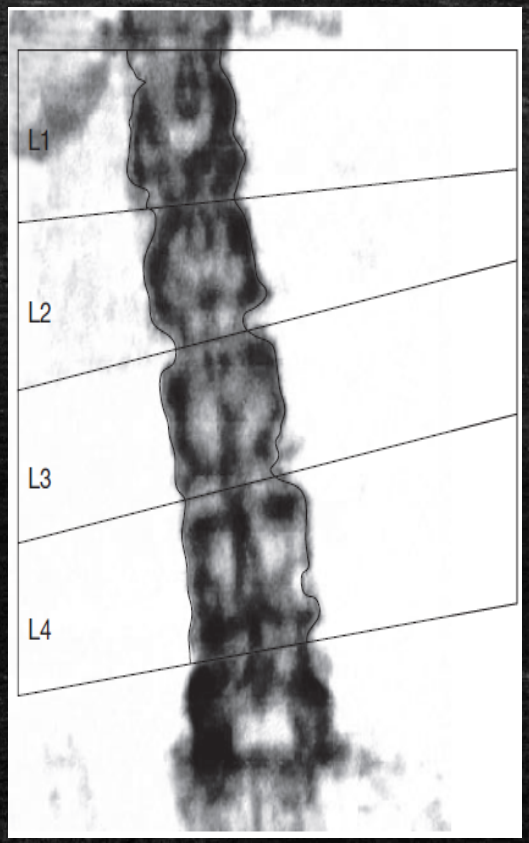
- Spine is centered
- Spine is straight (NO tilted)
- Both iliac crests are visible
- Scan includes middle L5 and middle T12

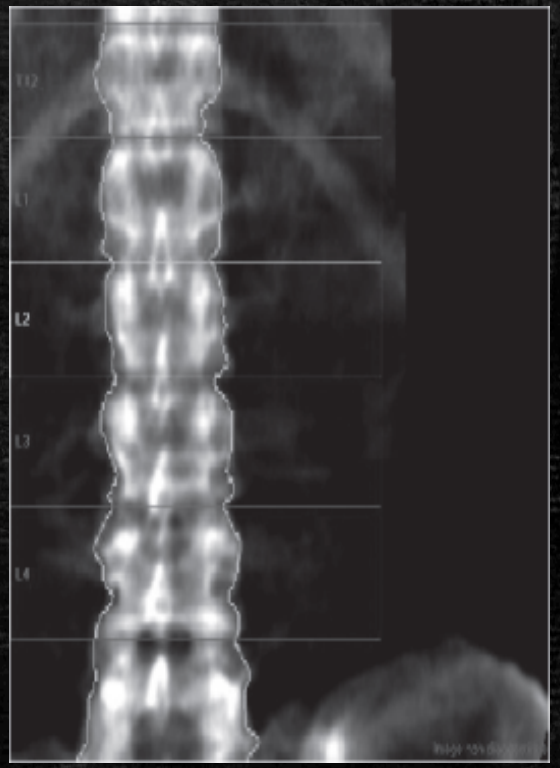
ACQUISITION PITFALL

IMPROPER PATIENT POSITIONING



DXA of the lumbar spine with poor positioning.





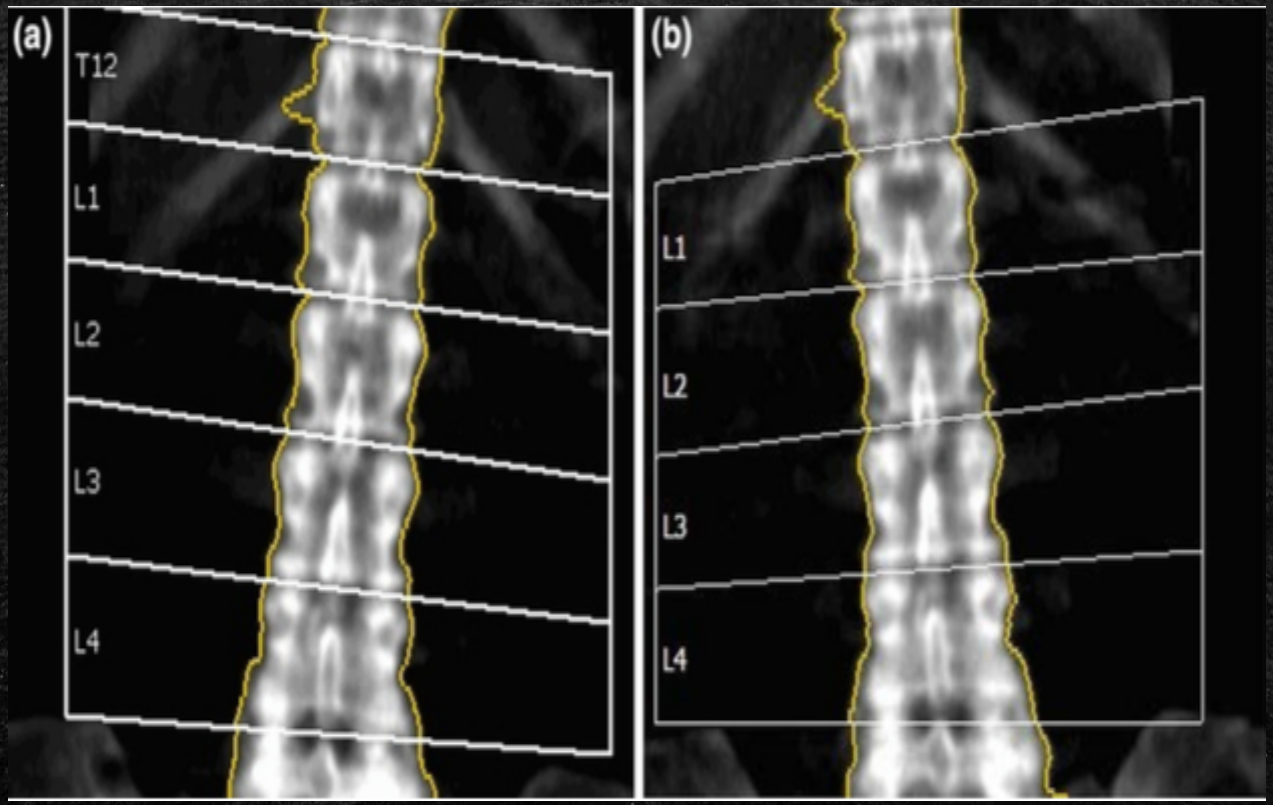
The spine is too close to the right side of the image

ACQUISITION PITFALL

IMPROPER PATIENT POSITIONING

BASELINE

FOLLOW-UP



The studies cannot be compared because of a marked change in patient positioning.

ACQUISITION PITFALL

(IM)PROPER PATIENT POSITIONING

Roma, 8-11 novembre 2018

ITALIAN CHAPTER

ISTITUTO AUXOLOGICO ITALIANO IRCCS

Via Ariosto 13
20145 MILANO

Telefono: 02/61911.1 E-mail: boneunit@auxologico.it Fax: 02/61911.2429

[illegible]	Sesso: Femmina	Altezza: 158.0 cm
ID paziente: 14AX00000428	Etnia: Bianco	Peso: 115.0 kg
Data di nascita: 12 May 1948	Menopause Age: 53	Età: 65

Medico di riferimento: ASL

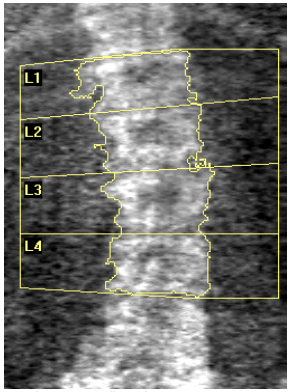


Immagine non per uso diagnostico
k = 1.119, d0 = 39.8
116 x 121

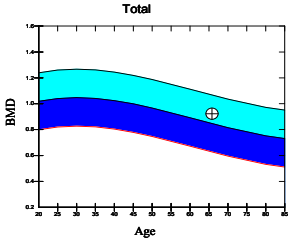
Informazioni sulla scansione:

Data scansione: 04 March 2014 ID: A0304140R
Tipo di scansione: a Lombare
Analisi: 04 March 2014 11:19 Versione 12.6.2:3
Lombare
Operator: AI
Model: Discovery A (S/N 80533)
Commento:

Riepilogo risultati DXA:

Regione	Area (cm²)	BMC (g)	BMD (g/cm²)	T - Punti	PR (%)	Z - Punti	AM (%)
L1	12.67	10.62	0.838	-0.8	91	0.8	112
L2	13.33	12.50	0.937	-0.8	91	1.0	113
L3	12.80	11.46	0.895	-1.7	83	0.2	102
L4	12.80	13.04	1.019	-0.9	91	1.1	113
Totale	**51.60**	**47.61**	**0.923**	**-1.1**	**88**	**0.7**	**109**

Totale BMD CV 1.0%, ACF = 1.029, BCF = 0.997, TH = 11.108



Curva di riferimento e punteggi corrispondenti a Bianco Femmina

Origine: Hologic

Commento del medico:

HOLOGIC®

ISTITUTO AUXOLOGICO ITALIANO IRCCS

Via Ariosto 13
20145 MILANO

Telefono: 02/61911.1 E-mail: boneunit@auxologico.it Fax: 02/61911.2429

[illegible]	Sesso: Femmina	Altezza: 160.0 cm
ID paziente: 10AX00000084	Etnia: Bianco	Peso: 40.0 kg
Data di nascita: 07 July 1926	Menopause Age: 55	Età: 87

Medico di riferimento: VOLPATO

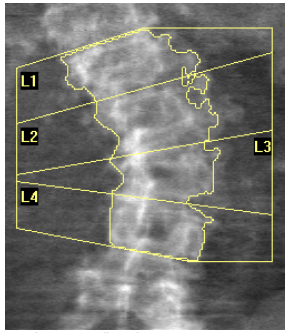


Immagine non per uso diagnostico
k = 1.132, d0 = 45.9
116 x 106

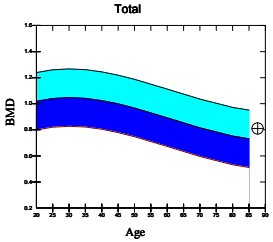
Informazioni sulla scansione:

Data scansione: 04 March 2014 ID: A0304140V
Tipo di scansione: a Lombare
Analisi: 04 March 2014 11:58 Versione 12.6.2:3
Lombare
Operator: AI
Model: Discovery A (S/N 80533)
Commento:

Riepilogo risultati DXA:

Regione	Area (cm²)	BMC (g)	BMD (g/cm²)	T - Punti	PR (%)	Z - Punti	AM (%)
L1	12.52	10.98	0.877	-0.4	95		
L2	13.34	10.10	0.757	-2.5	74		
L3	9.72	7.42	0.763	-2.9	70		
L4	10.37	8.73	0.841	-2.5	75		
Totale	**45.96**	**37.22**	**0.810**	**-2.2**	**77**		

Totale BMD CV 1.0%, ACF = 1.029, BCF = 0.997, TH = 6.314



Curva di riferimento e punteggi corrispondenti a Bianco Femmina

Origine: Hologic

Commento del medico:

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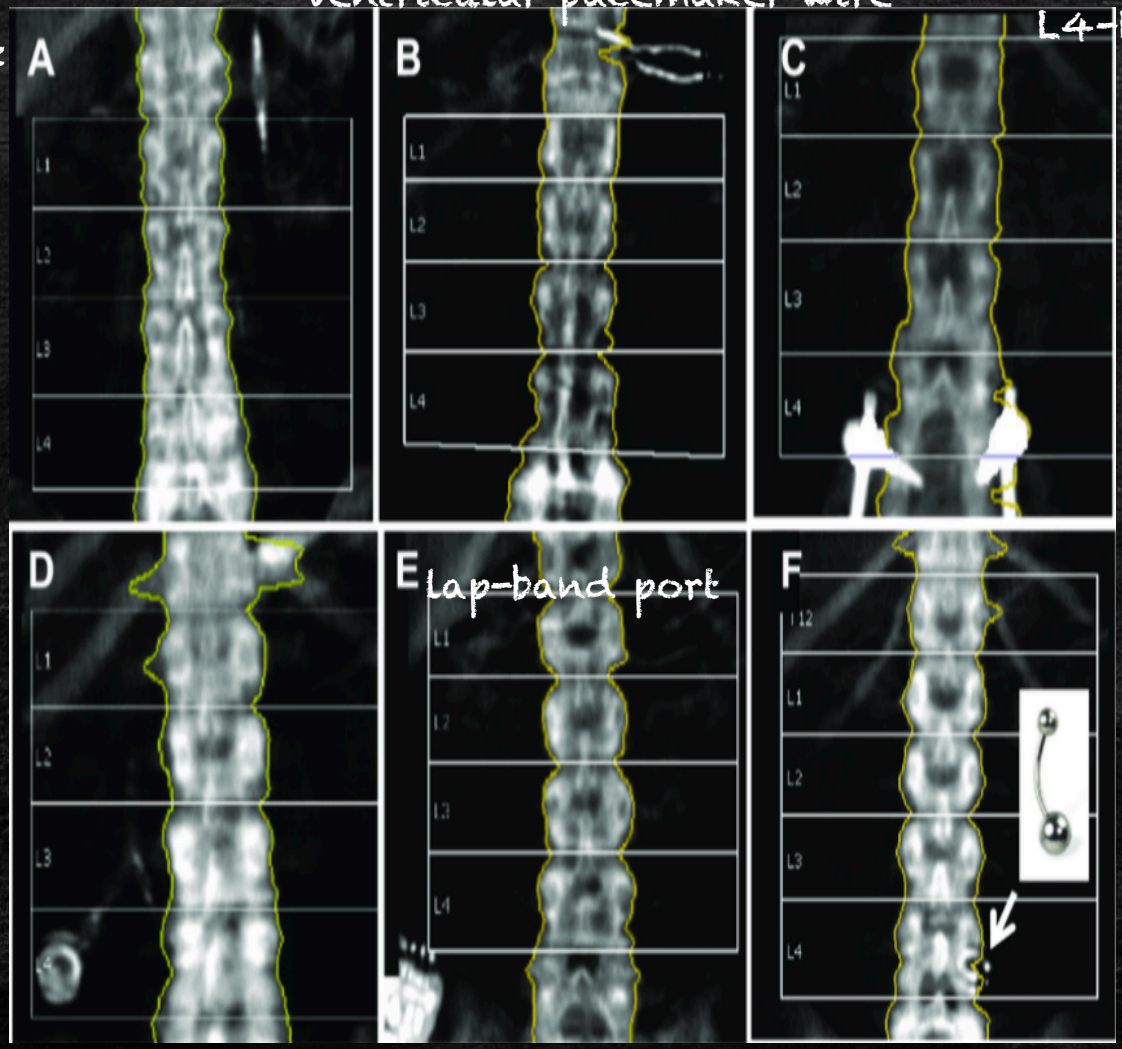
ACQUISITION PITFALL

External Artifacts not removed from scanned area

Ventriculo-peritoneal shunt connector

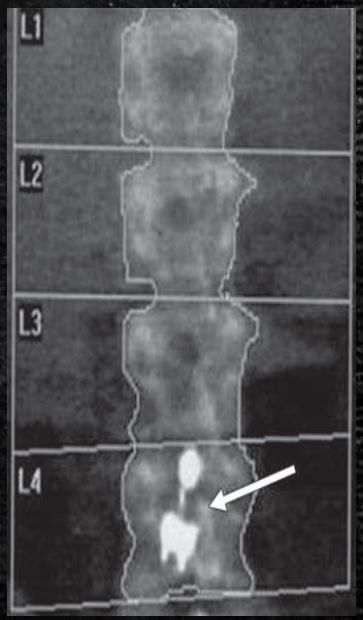
ventricular pacemaker wire

L4-L5 fusion hardware



sacral nerve stimulator

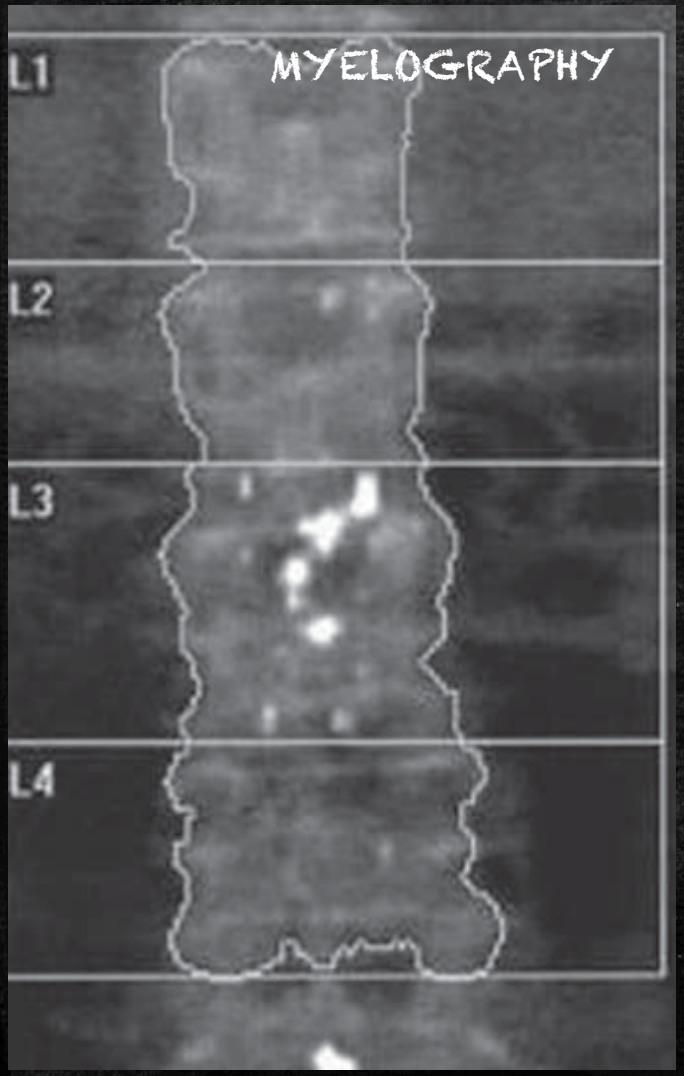
lap-band port



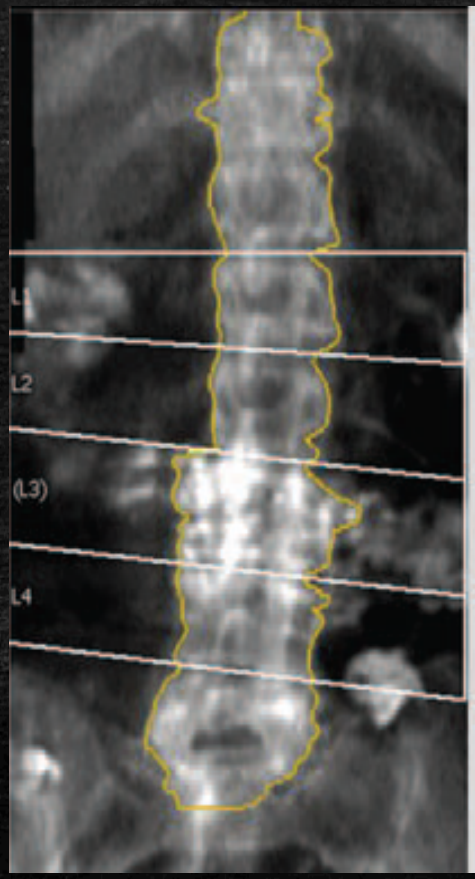
piercing

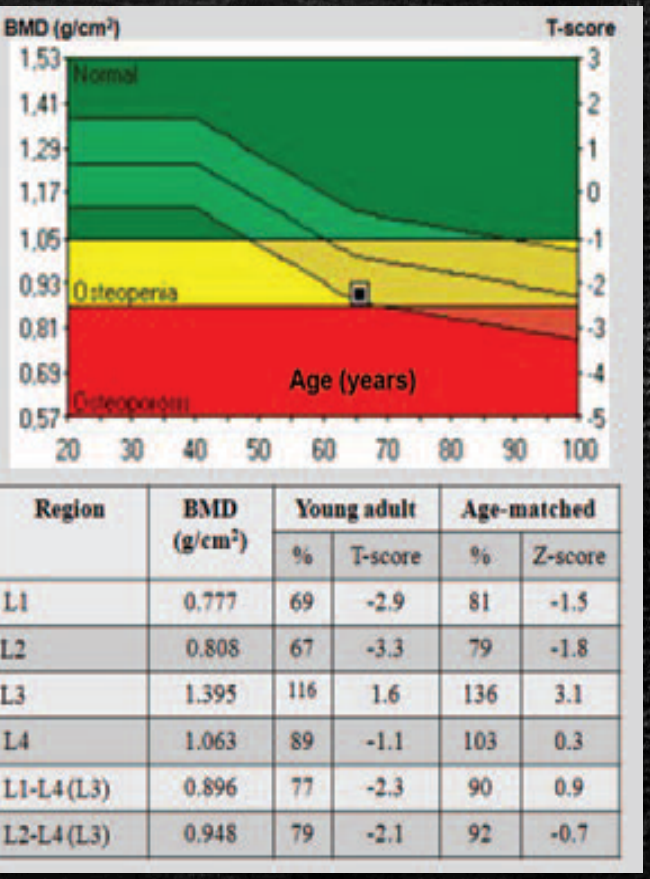
ACQUISITION PITFALL

Artifacts caused by contrast material



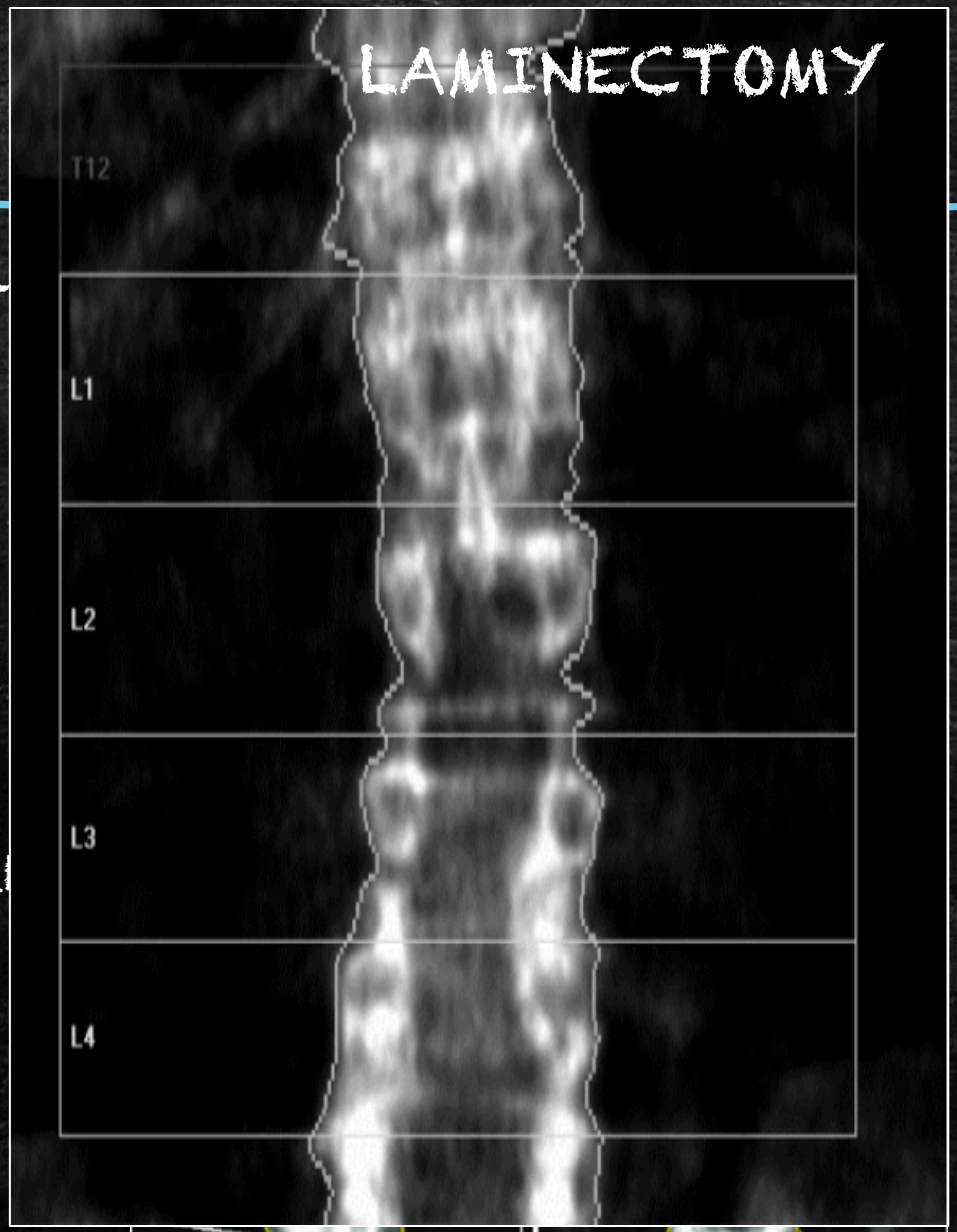
radio-opaque material
barium





Region	BMD (g/cm²)	Young adult		Age-matched	
		%	T-score	%	Z-score
L1	0.777	69	-2.9	81	-1.5
L2	0.808	67	-3.3	79	-1.8
L3	1.395	116	1.6	136	3.1
L4	1.063	89	-1.1	103	0.3
L1-L4 (L3)	0.896	77	-2.3	90	0.9
L2-L4 (L3)	0.948	79	-2.1	92	-0.7

ACQUISITION PITFALL



Porcelain gall

gallstones

calcified retroperitoneal lymph nodes

left renal stones

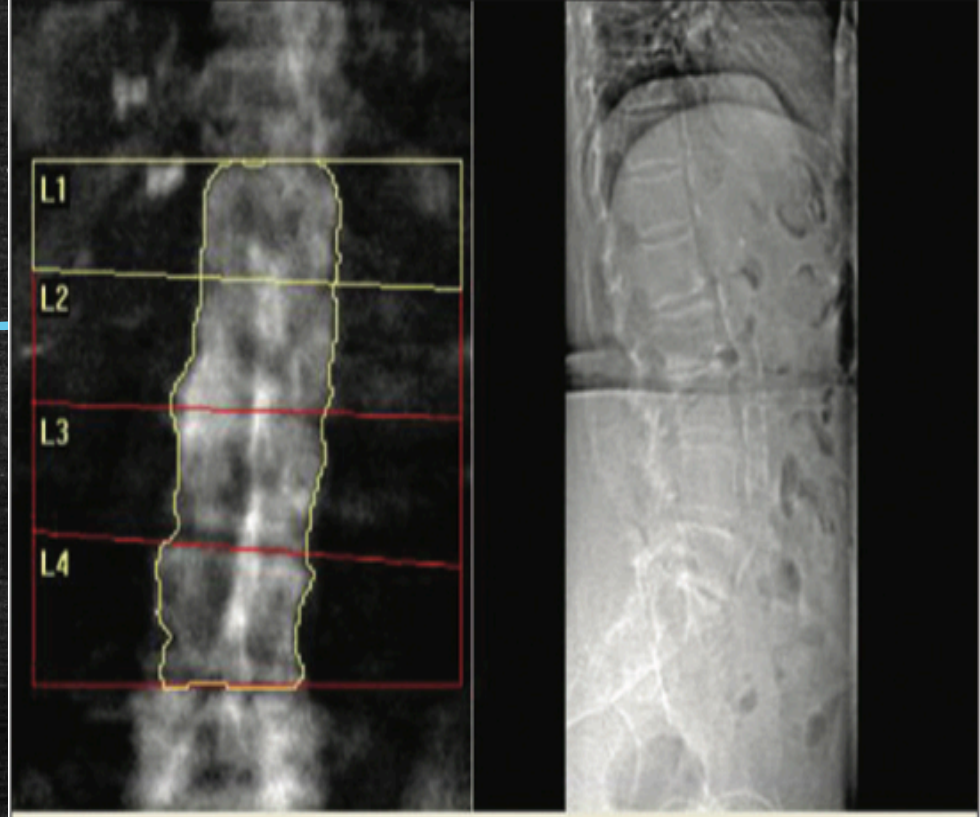
Roma, 8-11 novembre 2018

ITALIAN CHAPTER

ACQUISITION PITFALL

Internal artifacts

AORTIC CALCIFICATION leading to an increase in bone mineral density at L2 (also observe the difference of more than 1 SD between L1 and L2)



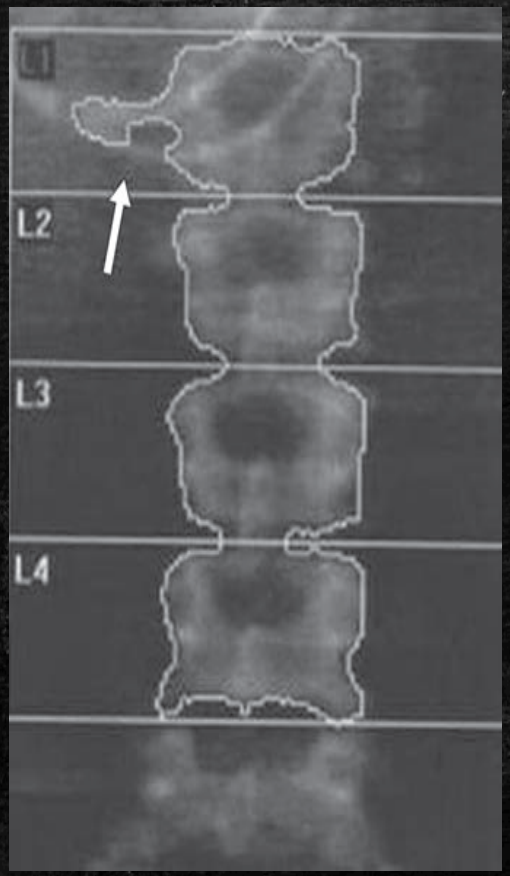
Region	Area (cm^2)	BMC (g)	BMD (g/cm^2)	T-score	Z-score
L1	8.92	6.50	0.729	-2.4	-0.3
L2	10.64	9.48	0.890	-1.3	1.1
L3	11.03	9.84	0.892	-1.7	0.7
L4	11.07	9.23	0.834	-2.1	0.5
TOTAL	41.67	35.05	0.841	-1.9	0.5

Roma, 8-11 novembre 2018

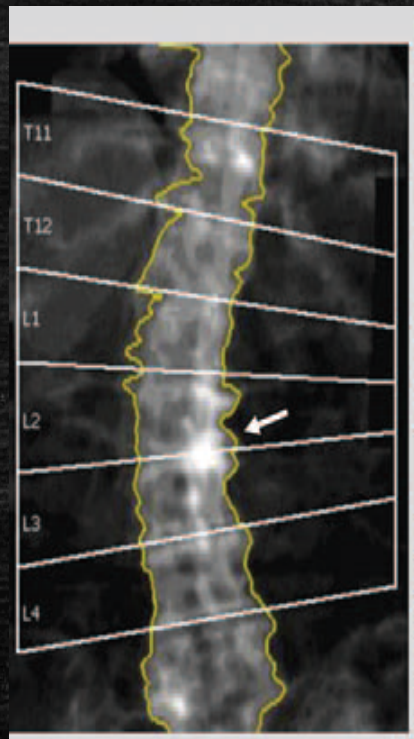
ITALIAN CHAPTER

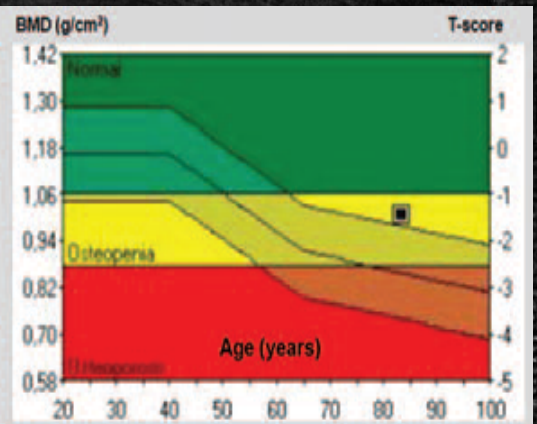
ANALYSIS PITTFALL

enteric tube



osteoarthrosis





Region	BMD (g/cm²)	Young adult		Age-matched	
		%	T-score	%	Z-score
L1	0.924	82	-1.7	114	1
L2	1.079	90	-1	123	1.7
L3	1.109	92	-0.8	126	1.9
L4	0.912	76	-2.4	104	0.3
L1-L4	1.006	85	-1.5	117	1.2
L2-L4	1.028	86	-1.4	117	1.2

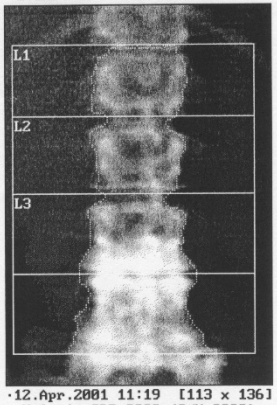
ANALYSIS PITTFALL

Roma, 8-11 novembre 2018

ITALIAN CHAPTER

ISTITUTO AUXOLOGICO ITALIANO IRCCS

k = 1.220 d0 = 116.7(0.999H) 6.290



·12.Apr.2001 11:19 [113 x 136]
Hologic QDR-2000 (S/N 2330)
Array Spine Hi-Res V4.76H:1

Q04120123 Thu 12.Apr.2001 11:14
Name: [redacted]
Comment: 59 MP FIS NO E
I.D.: 95AX14260000 Sex: F
S.S.#: 023-01-8712 Ethnic: W
ZIPCode: Height: 160.10 cm
Scan Code: 03 Weight: 57.00 kg
BirthDate: 07.Aug.23 Age: 77
Physician: ZENONI
Image not for diagnostic use

TOTAL BMD CV FOR L1 - L4 1.0%

C.F. 0.972 0.967 1.000

Region	Est.Area (cm^2)	Est.BMC (grams)	BMD (gms/cm^2)
L1	11.55	6.95	0.602
L2	12.16	8.24	0.678
L3	14.36	16.28	1.133
TOTAL	38.08	31.47	0.826

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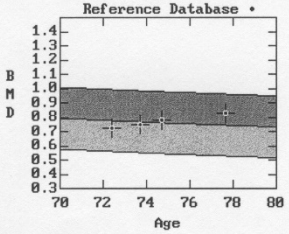
ISTITUTO AUXOLOGICO ITALIANO IRCCS

H Lumbar Spine
Reference Database •



Q04120123 Thu 12.Apr.2001 11:14
Name: GRASSI Giancarla
Comment: 59 MP FIS NO E
I.D.: 95AX14260000 Sex: F
S.S.#: 023-01-8712 Ethnic: W
ZIPCode: Height: 160.10 cm
Scan Code: 03 Weight: 57.00 kg
BirthDate: 07.Aug.23 Age: 77
Physician: ZENONI

L1-L3

Rate of Change/yr ±SD**	% Change ±% /yr SD
+0.0201 0.0021	+2.78 0.29

Date of Scan	Age	BMD(L1-L3)
02 Jan 96	72.4	0.722
30 Apr 97	73.7	0.743
21 Apr 98	74.7	0.778
12 Apr 01	77.7	0.826

**1.96xSD = 95% Confidence Interval
♦ Age and sex matched
T = peak BMD matched
Z = age matched TK 25 Oct 91

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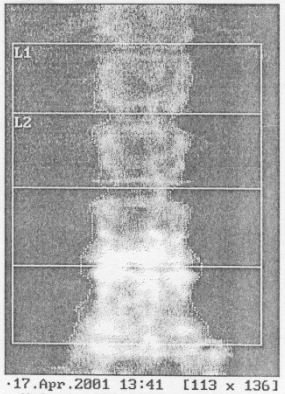
ISTITUTO AUXOLOGICO ITALIANO IRCCS

k = 1.220 d0 = 116.7(1.000H) 6.290



·17.Apr.2001 13:41 [113 x 136]
Hologic QDR-2000 (S/N 2330)
Array Spine Hi-Res V4.76H:1

Q04120123 Thu 12.Apr.2001 11:14
[redacted]SSI Giancarla
Comment: 59 MP FIS NO E
I.D.: 95AX14260000 Sex: F
S.S.#: 023-01-8712 Ethnic: W
ZIPCode: Height: 160.10 cm
Scan Code: 03 Weight: 57.00 kg
BirthDate: 07.Aug.23 Age: 77
Physician: ZENONI
Image not for diagnostic use

TOTAL BMD CV FOR L1 - L4 1.0%

C.F. 0.972 0.967 1.000

Region	Est.Area (cm^2)	Est.BMC (grams)	BMD (gms/cm^2)
L1	11.55	6.95	0.602
L2	12.16	8.24	0.678
TOTAL	23.72	15.19	0.641

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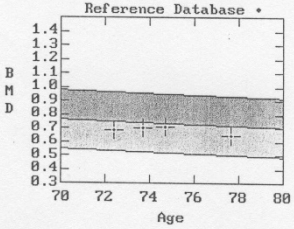
ISTITUTO AUXOLOGICO ITALIANO IRCCS

H Lumbar Spine
Reference Database •



Q04120123 Thu 12.Apr.2001 11:14
Name: GRASSI Giancarla
Comment: 59 MP FIS NO E
I.D.: 95AX14260000 Sex: F
S.S.#: 023-01-8712 Ethnic: W
ZIPCode: Height: 160.10 cm
Scan Code: 03 Weight: 57.00 kg
BirthDate: 07.Aug.23 Age: 77
Physician: ZENONI

L1L2

Rate of Change/yr ±SD**	% Change ±% /yr SD
-0.0089 0.0021	-1.31 0.30

Date of Scan	Age	BMD(L1L2)
02 Jan 96	72.4	0.681
30 Apr 97	73.7	0.695
21 Apr 98	74.7	0.704
12 Apr 01	77.7	0.641

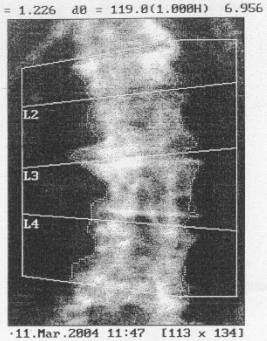
**1.96xSD = 95% Confidence Interval
♦ Age and sex matched
T = peak BMD matched
Z = age matched TK 25 Oct 91

HOLOGIC

ANALYSIS PITTFALL

ISTITUTO AUXOLOGICO ITALIANO IRCCS

k = 1.226 d0 = 119.0(1.000H) 6.956



·11.Mar.2004 11:47 [113 x 134]
Hologic QDR-2000 (S/N 2330)
Array Spine Medium V4.76A:1

Q0311
Name:
Comme
I.D.: 04AX00000466 Sex: F
S.S.#: 028-00-9912 Ethnic: W
ZIPCode: Height: 160.00 cm
Scan Code: 01 Weight: 54.00 kg
BirthDate: 18.Aug.22 Age: 81
Physician: ASL
Image not for diagnostic use

TOTAL BMD CV FOR L1 - L4 1.0%

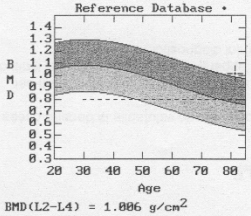
C.F. 0.962 0.955 1.000

Region	Est.Area (cm^2)	Est.BMC (grams)	BMD (gms/cm^2)
L2	15.74	14.44	0.917
L3	16.35	16.79	1.027
L4	17.78	18.94	1.065
TOTAL	49.86	58.17	1.006

HOLOGIC

ISTITUTO AUXOLOGICO ITALIANO IRCCS

A Lumbar Spine
Reference Database •



Q0311041D Thu 11.Mar.2004 11:42
Name: MANCA DI VILLAHERMOSA MARI
Comment: ISTER. 49 AA NO OVX DS
I.D.: 04AX00000466 Sex: F
S.S.#: 028-00-9912 Ethnic: W
ZIPCode: Height: 160.00 cm
Scan Code: 01 Weight: 54.00 kg
BirthDate: 18.Aug.22 Age: 81
Physician: ASL

BMD(L2-L4) = 1.006 g/cm^2

Region	BMD	T(30.0)		Z	
N/A					
L2	0.917	-1.00	89%	+1.69	125%
L3	1.027	-0.52	95%	+2.32	133%
L4	1.065	-0.46	95%	+2.46	134%
L2-L4	1.006	-0.66	93%	+2.16	131%

♦ Age and sex matched
T = peak BMD matched
Z = age matched TK 25 Oct 91

HOLOGIC

ISTITUTO AUXOLOGICO ITALIANO
ISTITUTO DI RICOVERO E CURA A CARATTERE SCIENTIFICO

Istituto Scientifico San Michele
20145 Milano - Via Ariosto, 13 Tel. 02-61911.1 Fax 02-61911.2429

MANCA DI VILLAHERMOSA MARIA CATERINA
VIA VOLTA 7
MILANO - 20100 MI

Cartella: 1021 del 11/03/2004

Milano, 11/03/2004

M.O.C. VERTEBRALE

L'esame è stato condotto sulla sola sede vertebrale non essendo valutabile la densità ossea femorale in presenza di impianto protesico bilaterale.
I valori di densità ossea del tratto vertebrale L2-L4 risultano sensibilmente sovrastimati per concomitanti fenomeni spondilo-artrosici pertanto, pur apparentemente conservati nei limiti di norma, vanno considerati scarsamente affidabili in termini diagnostici.

Lo Specialista
Dott. SERGIO ORTOLANI

rc 16/03/2004

VALORI DI RIFERIMENTO
BMD totale:

L1 - L4 0.830 - 1.350 (g/cm2)
L2 - L4 0.850 - 1.350 (g/cm2)

"N.B. Si consegnano con l'originale del referto le relative immagini e/o i relativi tracciati"

Sede Legale ed amministrativa: Via L. Ariosto 13 - 20145 Milano - Iscritta Registro Persone Giuridiche Prefettura di Milano N° 194 - CF e P.IVA 02703120150

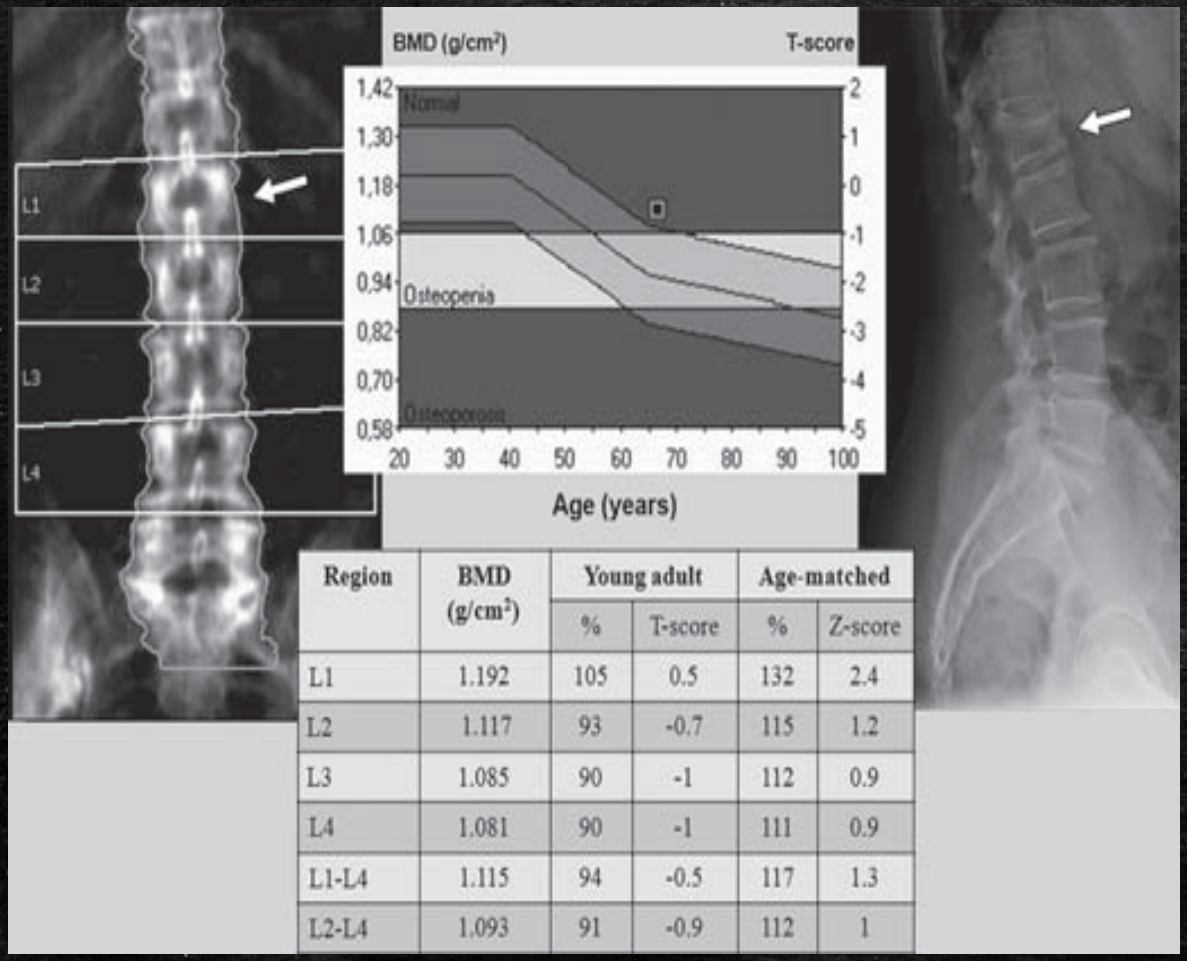
GREATLY OVERESTIMATED

Roma, 8-11 novembre 2018

ITALIAN CHAPTER

ANALYSIS

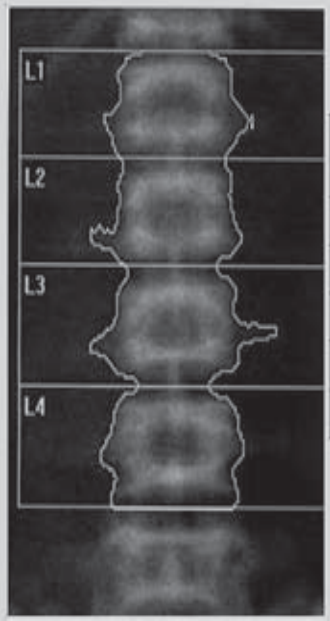
vertebral fracture



Region	BMD (g/cm²)	Young adult		Age-matched	
		%	T-score	%	Z-score
L1	1.192	105	0.5	132	2.4
L2	1.117	93	-0.7	115	1.2
L3	1.085	90	-1	112	0.9
L4	1.081	90	-1	111	0.9
L1-L4	1.115	94	-0.5	117	1.3
L2-L4	1.093	91	-0.9	112	1

ANALYSIS other diseases

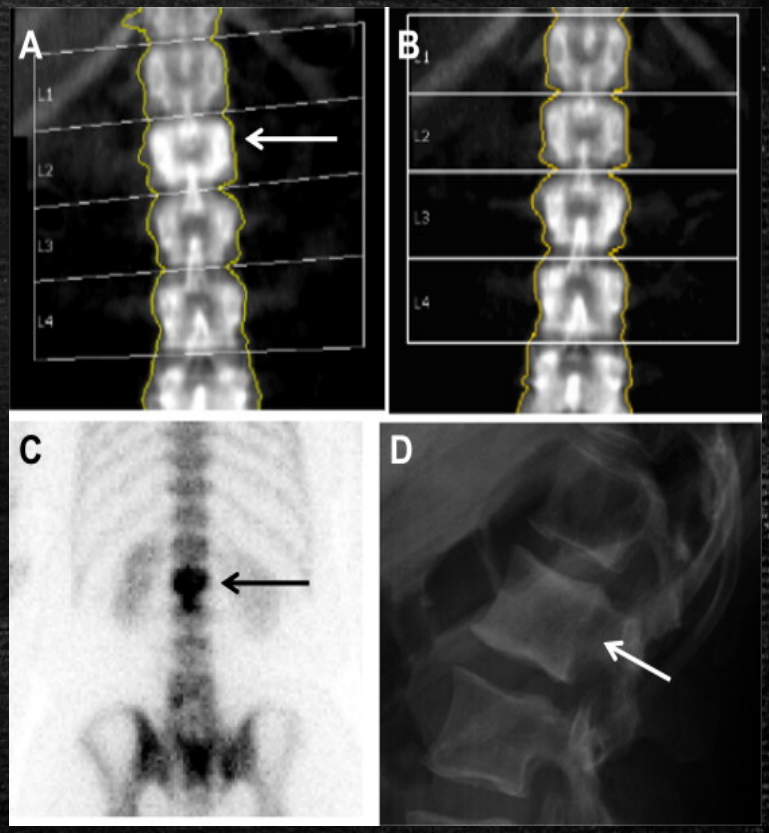
OSTEOPETROSIS



DXA Results Summary

Region	Area (cm^2)	BMC (g)	BMD (g/cm^2)	T-score	%	Z-score	%
L1	13.53	27.15	2.007	9.8	217	10.5	237
L2	13.60	30.11	2.214	10.8	215	11.6	235
L3	16.03	35.28	2.202	10.2	203	11.0	222
L4	16.44	34.45	2.095	8.9	188	9.8	205
Total	59.60	126.99	2.131	9.9	204	10.7	222

Total BMD CV 1.0%, ACF=1.030, BCF=1.006, TH=6.565
WHO Classification: Normal
Fracture risk: Not increased



PAGET DISEASE

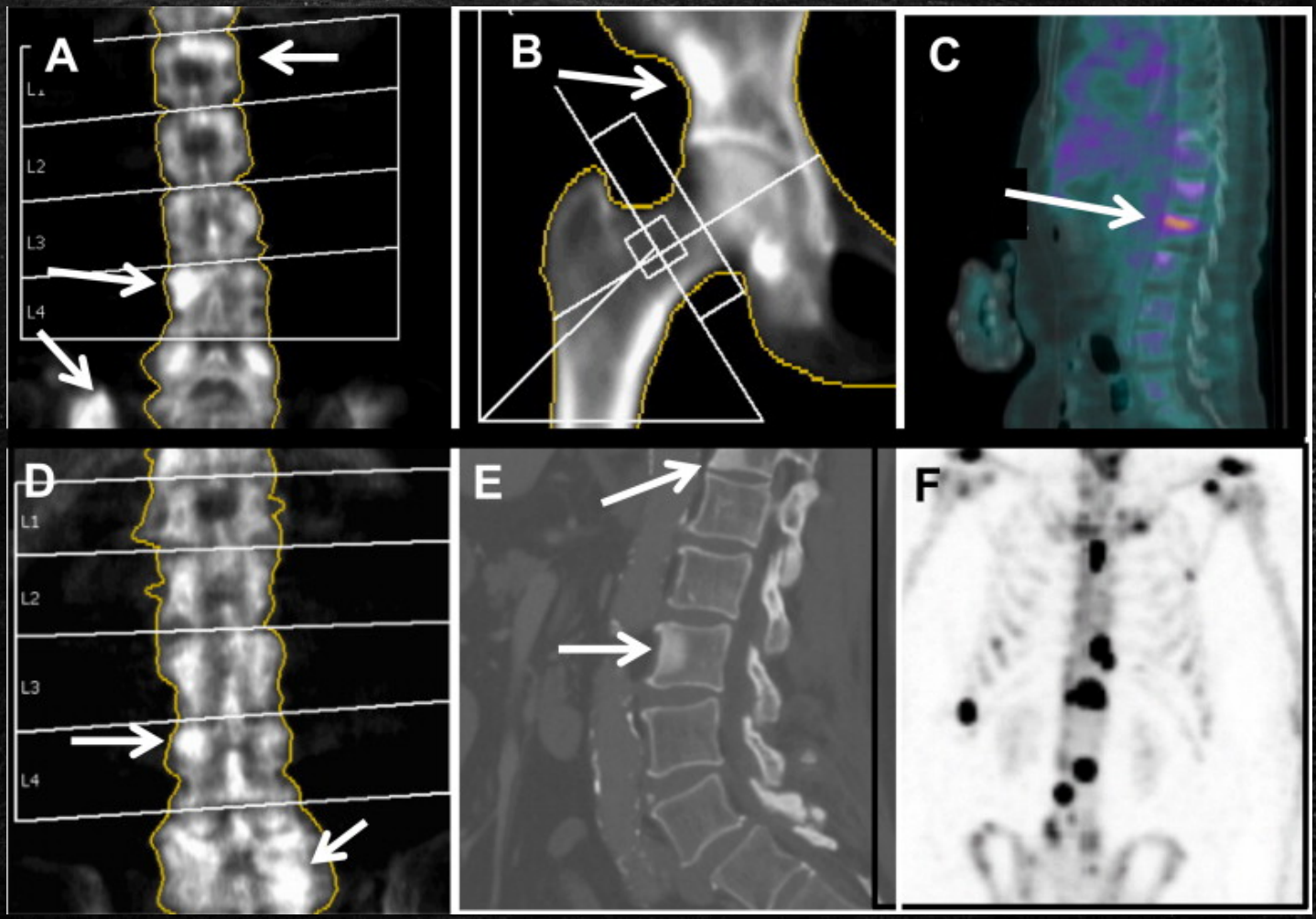
Roma, 8-11 novembre 2018

ITALIAN CHAPTER

ANALYSIS

Metastases from breast cancer

DANGER



Roma, 8-11 novembre 2018

ITALIAN CHAPTER

LUMBAR SPINE: GOOD FOLLOW-UP SCAN ?

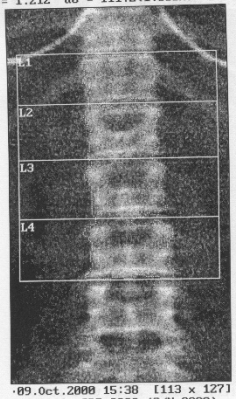
SAME EXACT TEMPLATE

≠

NUMBERING OF THE VERTEBRAE

ISTITUTO AUXOLOGICO ITALIANO IRCCS

k = 1.212 d0 = 111.2(1.000H) 8.021



·09.Oct.2000 15:38 [113 x 127]
Hologic QDR-2000 (S/N 2330)

Q10090033 Mon 09.Oct.2000 15:33
Name: [redacted]
Comment: MP.50
I.D.: 00AX00003313 Sex: F
S.S.#: 023-00-0000 Ethnic: W
ZIPCode: Height: 154.00 cm
Scan Code: 01 Weight: 71.50 kg
BirthDate: 13.Aug.39 Age: 61
Physician:
Image not for diagnostic use

TOTAL BMD CV FOR L1 - L4 1.0%

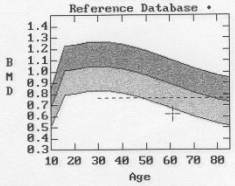
C.F.	0.972	0.967	1.000

Region	Est.Area (cm²)	Est.BMC (grams)	BMD (gms/cm²)
L1	9.30	5.02	0.540
L2	10.77	6.49	0.603
L3	12.56	8.08	0.643
L4	13.85	9.20	0.664
TOTAL	46.47	28.78	0.619

HOLOGIC

ISTITUTO AUXOLOGICO ITALIANO IRCCS

A Lumbar Spine
Reference Database •



Q10090033 Mon 09.Oct.2000 15:33
Name: INVERNIZZI NELLY
Comment: MP.50
I.D.: 00AX00003313 Sex: F
S.S.#: 023-00-0000 Ethnic: W
ZIPCode: Height: 154.00 cm
Scan Code: 01 Weight: 71.50 kg
BirthDate: 13.Aug.39 Age: 61
Physician:

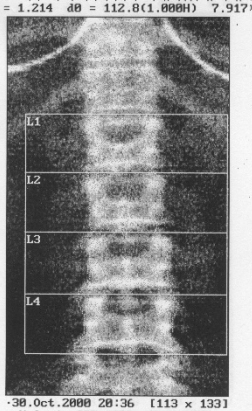
BMD(L1-L4) = 0.619 g/cm²

Region	BMD	T(30.0)		Z	
L1	0.540	-3.50	58%	-2.18	69%
L2	0.603	-3.87	59%	-2.40	70%
L3	0.643	-4.01	59%	-2.46	70%
L4	0.664	-4.11	60%	-2.52	71%
L1-L4	0.619	-3.89	59%	-2.40	70%

• Age and sex matched
T = peak BMD matched
Z = age matched TK 04 Nov 91

ISTITUTO AUXOLOGICO ITALIANO IRCCS

k = 1.214 d0 = 112.8(1.000H) 7.917



·30.Oct.2000 20:36 [113 x 133]
Hologic QDR-2000 (S/N 2330)

Q10090033 Mon 09.Oct.2000 15:33
Name: [redacted]
Comment: MP.50
I.D.: 00AX00003313 Sex: F
S.S.#: 023-00-0000 Ethnic: W
ZIPCode: Height: 154.00 cm
Scan Code: 01 Weight: 71.50 kg
BirthDate: 13.Aug.39 Age: 61
Physician:
Image not for diagnostic use

TOTAL BMD CV FOR L1 - L4 1.0%

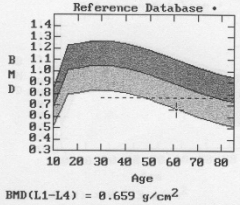
C.F.	0.972	0.967	1.000

Region	Est.Area (cm²)	Est.BMC (grams)	BMD (gms/cm²)
L1	10.93	6.49	0.594
L2	12.73	8.23	0.646
L3	14.68	9.35	0.637
L4	15.84	11.67	0.736
TOTAL	54.20	35.74	0.659

HOLOGIC

ISTITUTO AUXOLOGICO ITALIANO IRCCS

A Lumbar Spine
Reference Database •



Q10090033 Mon 09.Oct.2000 15:33
Name: INVERNIZZI NELLY
Comment: MP.50
I.D.: 00AX00003313 Sex: F
S.S.#: 023-00-0000 Ethnic: W
ZIPCode: Height: 154.00 cm
Scan Code: 01 Weight: 71.50 kg
BirthDate: 13.Aug.39 Age: 61
Physician:

BMD(L1-L4) = 0.659 g/cm²

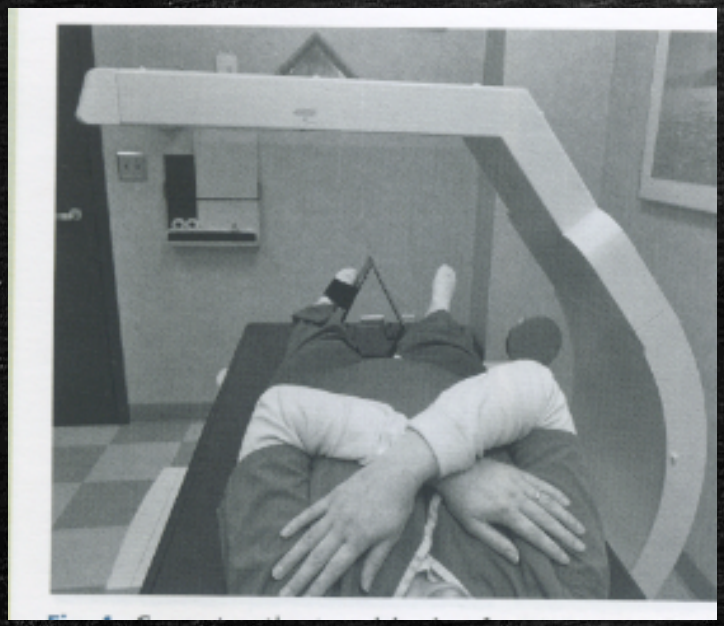
Region	BMD	T(30.0)		Z	
L1	0.594	-3.01	64%	-1.69	76%
L2	0.646	-3.47	63%	-2.01	75%
L3	0.637	-4.06	59%	-2.52	70%
L4	0.736	-3.45	66%	-1.86	78%
L1-L4	0.659	-3.52	63%	-2.03	75%

• Age and sex matched
T = peak BMD matched
Z = age matched TK 04 Nov 91

HOLOGIC

HIP

HIP MUST BE INTERNALLY ROTATED



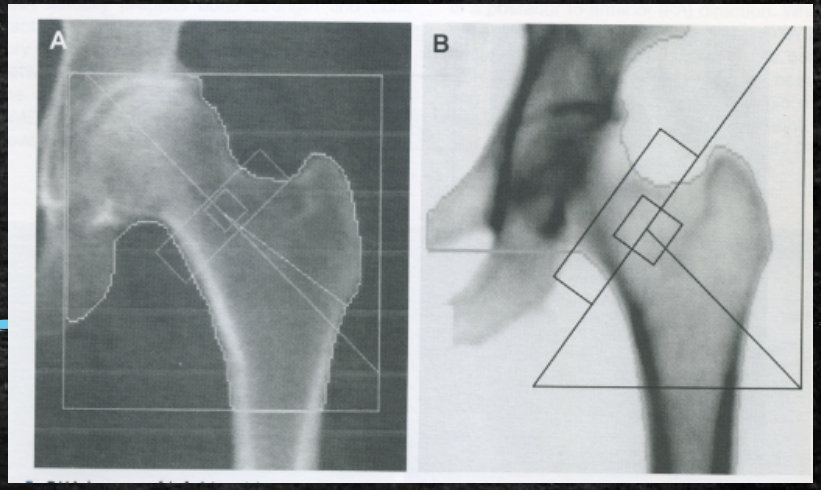
proximal femur: supine with lower extremity internally rotated 15°-30° and slightly abducted to keep femoral axis straight.

Roma, 8-11 novembre 2018

HIP

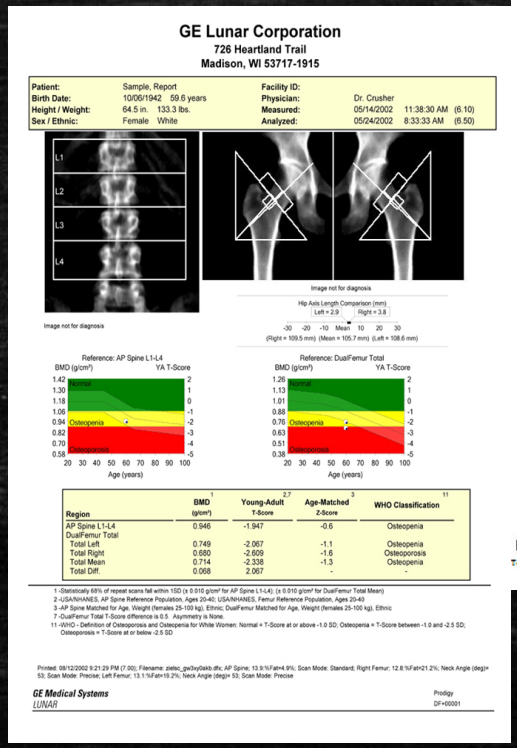
Anatomic Regions of Interest (ROIs)

- Total Hip
- Femoral Neck



Why Not Use Ward's Area?

- Using Ward's area would overestimate the prevalence of osteoporosis
- It is a small calculated area of the mid portion of the femoral neck where BMD is the lowest - not a well defined anatomic region
- Poor precision and accuracy
- Not part of WHO (World Health Organization) criteria for BMD classification



GE Lunar Corporation
726 Heartland Trail
Madison, WI 53717-1915

Patient:	Sample, Report	Facility ID:	
Birth Date:	10/06/1942 59.6 years	Physician:	Dr. Crusher
Height / Weight:	64.5 in. 133.3 lbs.	Measured:	05/14/2002 11:38:30 AM (6.10)
Sex / Ethnic:	Female White	Analyzed:	05/24/2002 8:33:33 AM (6.50)

Image not for diagnosis

Hip Axis Length Comparison (mm)
Left = 2.9 Right = 3.8
-30 -20 -10 Mean 10 20 30
(Right = 109.5 mm) (Mean = 105.7 mm) (Left = 108.6 mm)

Reference: AP Spine L1-L4
BMD (g/cm²) YA T-Score
Normal
Osteopenia
Osteoporosis
Age (years)

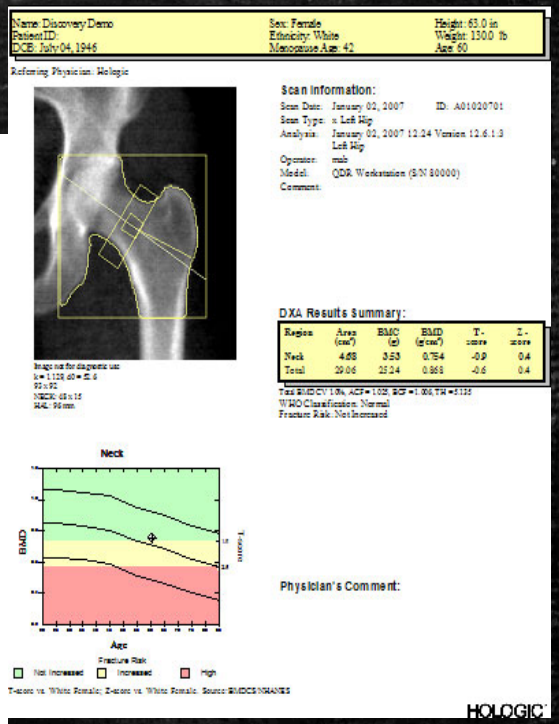
Reference: DualFemur Total
BMD (g/cm²) YA T-Score
Normal
Osteopenia
Osteoporosis
Age (years)

Region	BMD[1] (g/cm²)	Young-Adult[2,7] T-Score	Age-Matched[3] Z-Score	WHO Classification[11]
AP Spine L1-L4	0.946	-1.947	-0.6	Osteopenia
DualFemur Total				
Total Left	0.749	-2.067	-1.1	Osteopenia
Total Right	0.680	-2.609	-1.6	Osteoporosis
Total Mean	0.714	-2.338	-1.3	Osteopenia
Total Diff.	0.068	2.067	-	-

1 -Statistically 68% of repeat scans fall within 1SD (± 0.010 g/cm² for AP Spine L1-L4); (± 0.010 g/cm² for DualFemur Total Mean)
2 -USA/NHANES, AP Spine Reference Population, Ages 20-40; USA/NHANES, Femur Reference Population, Ages 20-40
3 -AP Spine Matched for Age, Weight (females 25-100 kg), Ethnic; DualFemur Matched for Age, Weight (females 25-100 kg), Ethnic
7 -DualFemur Total T-Score difference is 0.5. Asymmetry is None.
11 -WHO - Definition of Osteoporosis and Osteopenia for White Women: Normal = T-Score at or above -1.0 SD; Osteopenia = T-Score between -1.0 and -2.5 SD; Osteoporosis = T-Score at or below -2.5 SD

Printed: 08/12/2002 9:21:29 PM (7.00); Filename: zielsc_gw3xy0skb.dfx; AP Spine; 13.9:%Fat=4.9%; Scan Mode: Standard; Right Femur; 12.8:%Fat=21.2%; Neck Angle (deg)= 53; Scan Mode: Precise; Left Femur; 13.1:%Fat=19.2%; Neck Angle (deg)= 53; Scan Mode: Precise

GE Medical Systems
LUNAR
Prodigy
DF+00001



Name: Discovery Demo
Patient ID:
DOB: July 04, 1946
Sex: Female
Ethnicity: White
Menopause Age: 42
Height: 63.0 in
Weight: 130.0 lb
Age: 60

Referring Physician: Hologic

Scan Information:
Scan Date: January 02, 2007 ID: A01020701
Scan Type: x Left Hip
Analysis: January 02, 2007 12:24 Version 12.6.1.3 Left Hip
Operator: mab
Model: QDR Workstation (S/N 80000)
Comment:

Image not for diagnostic use
k = 1.129, d0 = 52.6
92 x 92
NECK: 68 x 15
HAL: 96 mm

DXA Results Summary:

Region	Area (cm²)	BMC (g)	BMD (g/cm²)	T-score	Z-score
Neck	4.68	3.53	0.754	-0.9	0.4
Total	29.06	25.24	0.868	-0.6	0.4

Total BMD CV 1.0%, ACF = 1.025, BCF = 1.006, TH = 5.135
WHO Classification: Normal
Fracture Risk: Not Increased

Neck
BMD
T-score
Age
Fracture Risk
Not Increased Increased High

Physician's Comment:

T-score vs. White Female; Z-score vs. White Female. Source: BMDCS/NHANES

HOLOGIC

ITALIAN CHAPTER

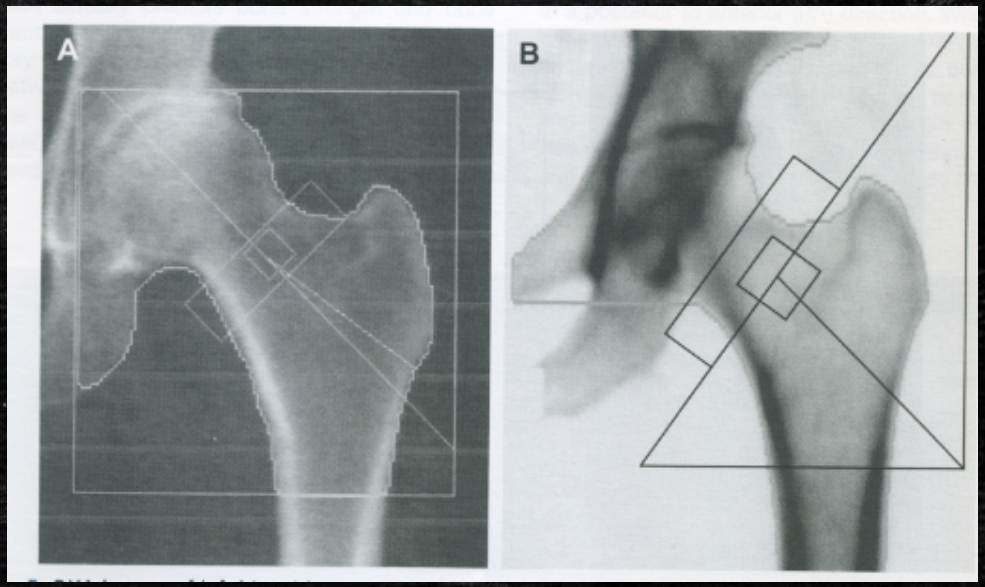
FEMUR: INTERNALLY ROTATED

- Shaft of femur should be parallel with the long axis of the table
- Hip must be internally rotated of 15%
- If patient cannot rotate, then make sure technician tries to reproduce the same positioning for the follow-up scans

ISCD Official Positions 2015

PROXIMAL FEMUR: OPTIMAL POSITIONING

- Femur shaft is straight
- Leg internally rotated
  - Lesser trochanter small or not seen (lesser trochanter is a posterior structure)
  - Its size is the best indicator of internal rotation
- Scan includes
  - Ischium
  - Greater trochanter



Roma, 8-11 novembre 2018

HIP REPOSITIONING

2013
1.009 g/cm2

2015 Initial
1.017 g/cm2
+ 0.008

2015 Repositioning
+0-966 g/cm2
-0.043

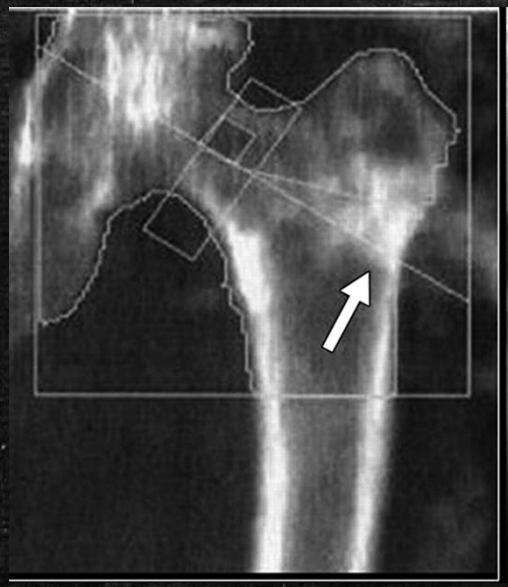
ACQUISITION PITFALL

Improper patient positioning

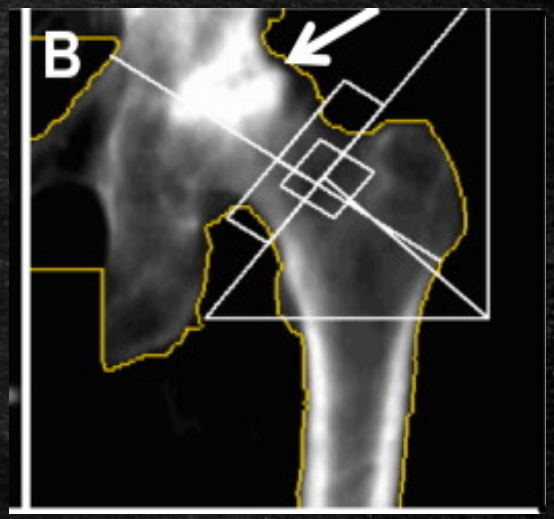
The femur is adducted

The femur is abducted

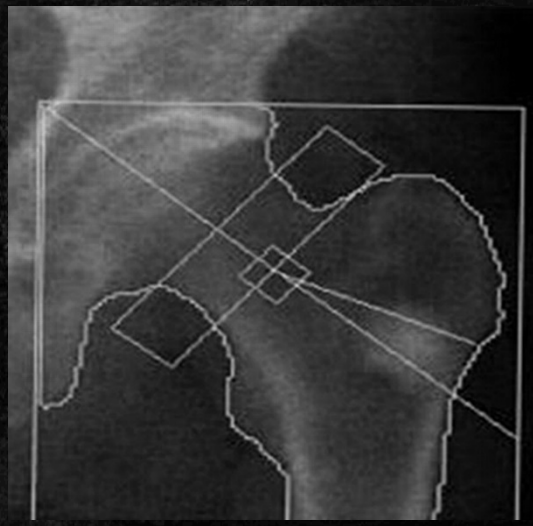
ANALYSIS
Internal artifacts



dermatomiositis



avascular necrosis of the left femoral head

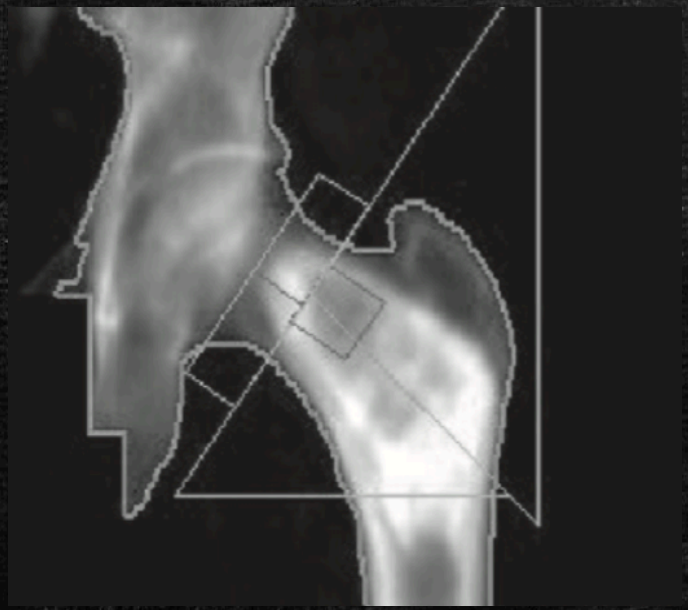


osteosclerosis

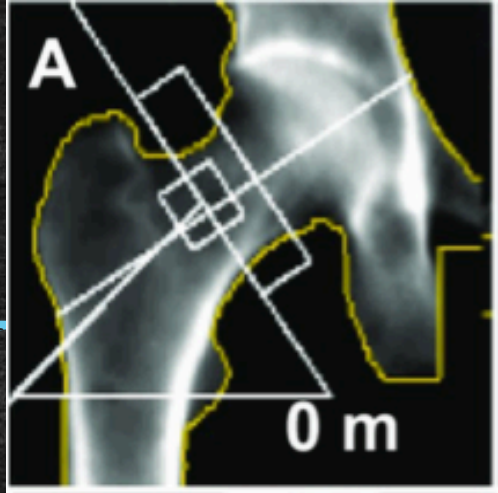
Roma, 8-11 novembre 2018

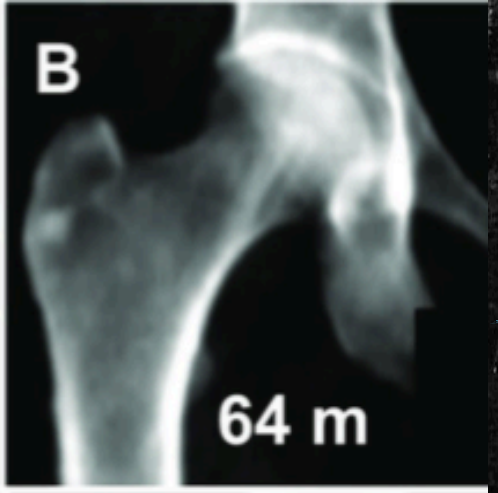
ITALIAN CHAPTER

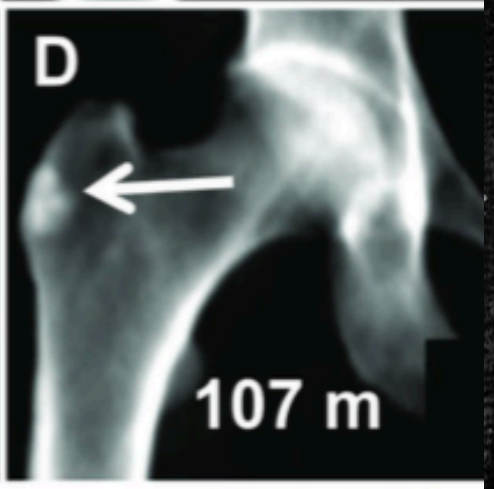
ANALYSIS
Internal artifacts



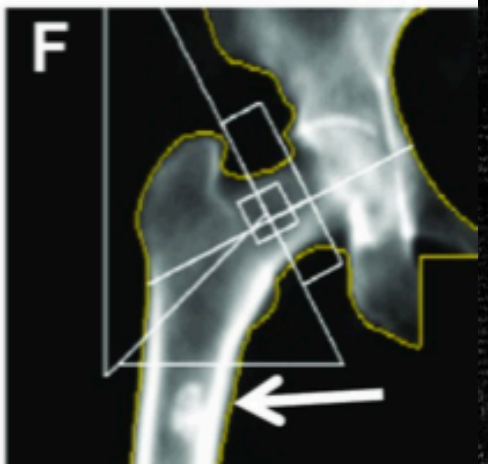
history of hip fracture and osteosynthesis





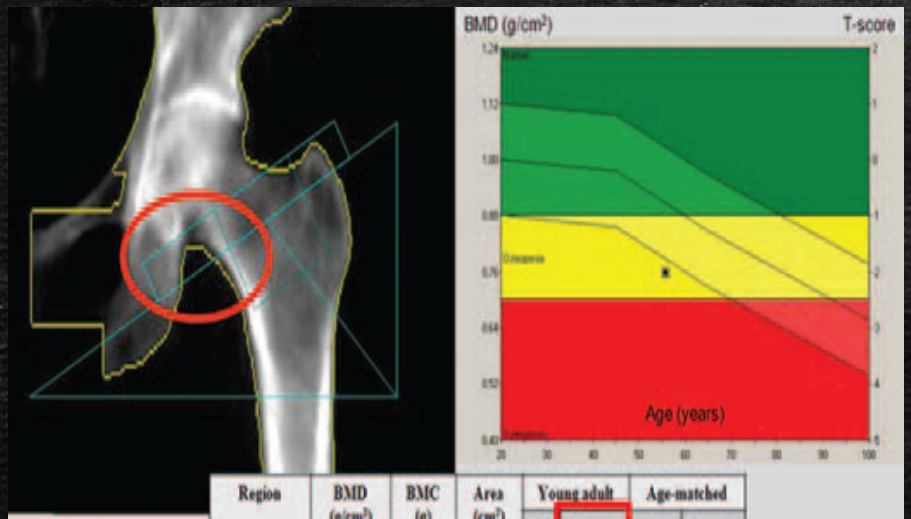


Enchondroma incidentally detected in the proximal femoral

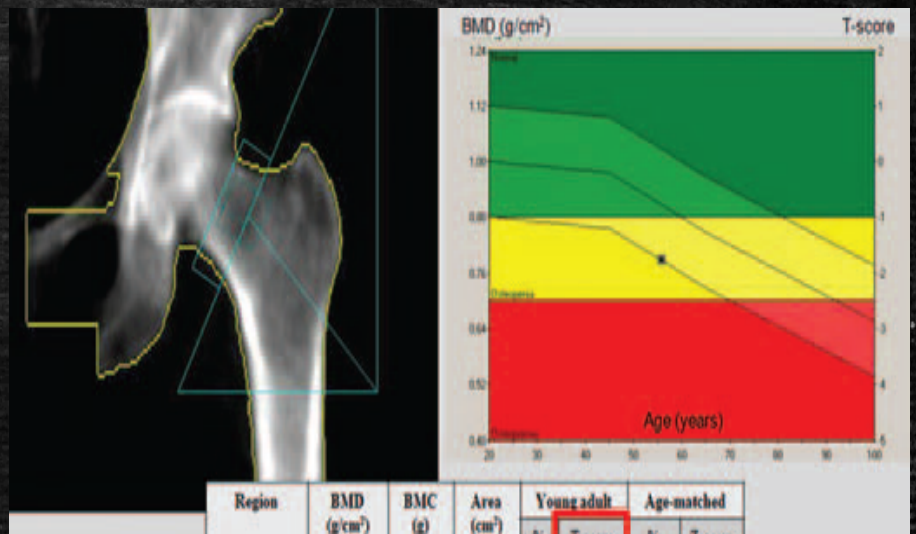


ANALYSIS

Placement of region of interest



Region	BMD (g/cm²)	BMC (g)	Area (cm²)	Young adult		Age-matched	
				%	T-score	%	Z-score
Neck	0.666	5.20	7.80	68	-2.6	78	-1.6
Sup. Neck	0.515	2.02	3.92	-	-	-	-
Inf. Neck	0.818	3.17	3.88	-	-	-	-
Ward	0.698	6.99	10.01	77	-1.6	101	01
Intertrochanter	0.609	4.22	6.93	77	-1.6	85	-1.0
Diaphysis	0.855	15.16	17.72	-	-	-	-
Total	0.757	24.57	32.46	76	-2.0	83	-1.2



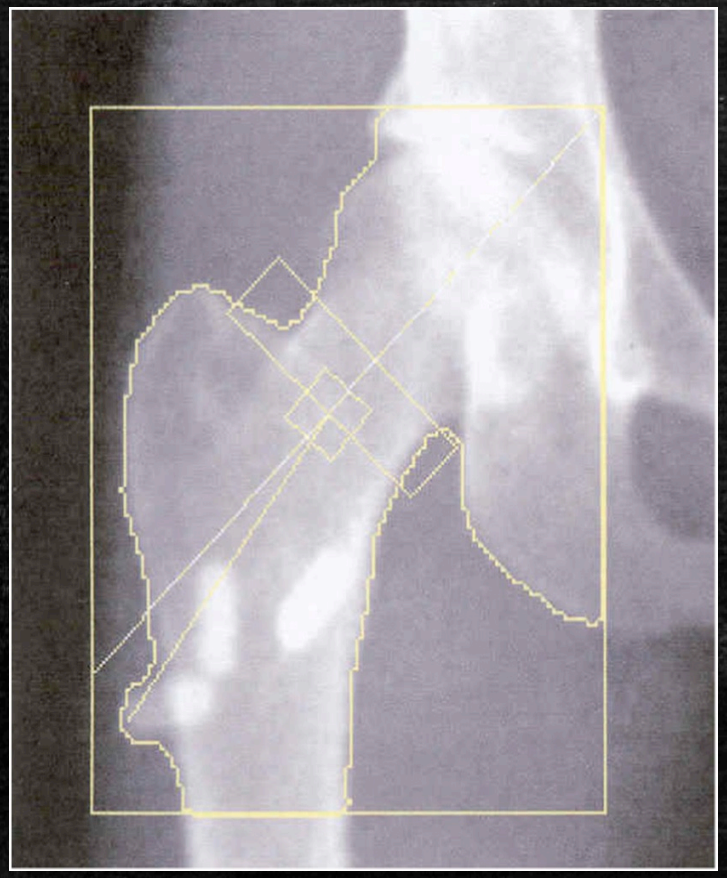
Region	BMD (g/cm²)	BMC (g)	Area (cm²)	Young adult		Age-matched	
				%	T-score	%	Z-score
Neck	0.732	2.82	3.86	75	-2.1	86	-1.0
Sup. Neck	0.588	1.10	1.87	-	-	-	-
Inf. Neck	0.869	1.73	1.99	-	-	-	-
Ward	0.593	1.49	2.51	65	-2.4	86	-0.8
Intertrochanter	0.589	6.05	10.28	75	-1.8	82	-1.2
Diaphysis	0.967	12.28	12.70	-	-	-	-
Total	0.788	21.15	26.84	79	-1.8	87	-1.0

Lorente-Ramos R, Azpeitia-Armán J, Muñoz-Hernández A, García-Gómez JM, Díez-Martínez P, Grande-Bárez M. Dual-energy x-ray absorptiometry in the diagnosis of osteoporosis: a practical guide. AJR Am J Roentgenol. 2011 Apr;196(4):897-904.

ACQUISITION PITFALL

External Artifacts not removed from scanned area

Two Calcium tablets and one multiple vitamin



COMPARE

If the precision assessment has been performed on the facility, future scans should be compared to previous scans using the quantitative comparison system

L1-L3

Rate of Change/yr ±SD**	% Change ±% /yr SD
+0.0201 0.0021	+2.78 0.29

Source: Hologic

DXA Results Summary: L4

Scan Date	Age	BMD (g/cm²)	T-Score	BMD Change vs Baseline	BMD Change vs Previous
12.04.2005	77	0.684	-3.9	14.3%#	9.4%#
26.11.2003	75	0.625	-4.5	4.5%*	0.4%
07.10.2002	74	0.623	-4.5	4.2%*	-6.1%*
01.06.2001	73	0.663	-4.1	10.9%*	6.5%*
19.04.2000	72	0.623	-4.5	4.1%*	4.1%*
24.07.1997	69	0.598	-4.7		

Total BMD CV 1.0%

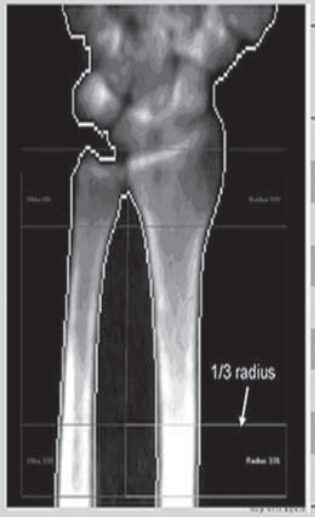
* Denotes significant change at the 95% confidence level.
# Denotes dissimilar scan types or analysis methods.
Rate of change results reflect vertebral levels common to all scans.

Roma, 8-11 novembre 2018

ITALIAN CHAPTER

FOREARM: OPTIMAL POSITIONING

Sitting beside table with forearm resting on table, hand pronated and held by straps.

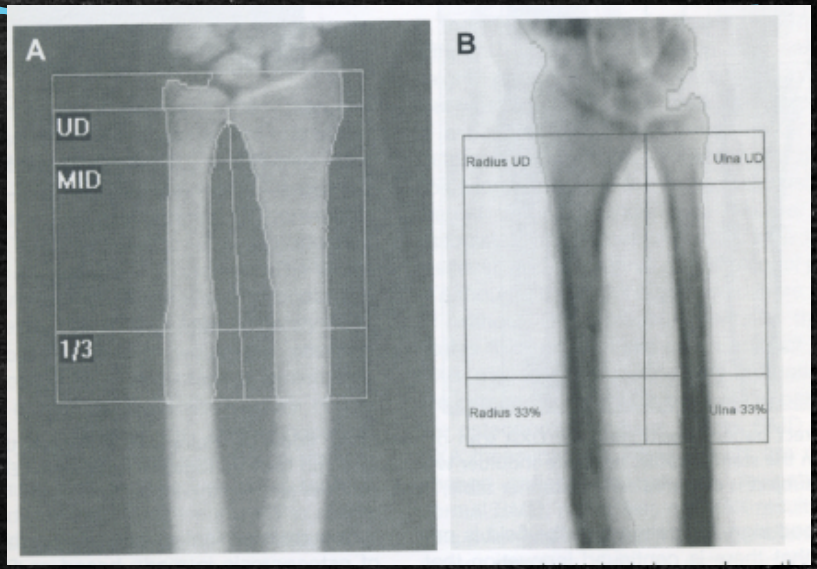


Region	BMD (g/cm²)	Young adult		Age-matched	
		%	T-score	%	Z-score
UD radius	0.456	97	-0.3	105	0.5
UD ulna	0.316	-	-	-	-
1/3 radius	0.866	98	-0.2	106	0.5
1/3 ulna	0.926	-	-	-	-
Both UD	0.408	-	-	-	-
Both 1/3	0.894	-	-	-	-
Total radius	0.692	101	0.2	109	0.9
Total ulna	0.654	-	-	-	-
Both total	0.677	-	-	-	-

Khojastehpour L, Mogharrabi S, **Dabbaghmanesh** MH, Iraji Nasrabadi N. **Comparison of the mandibular bone densitometry measurement between normal, osteopenic and osteoporotic postmenopausal women.** J Dent (Tehran). 2013 May;10(3):203-9.

FOREARM: OPTIMAL POSITIONING

- Forearm is centered
- Radius and ulna straight
- Distal cortex of radius and ulna
- No available artifacts



Forearm 1/3 radius accepted as diagnostic if it is osteoporotic

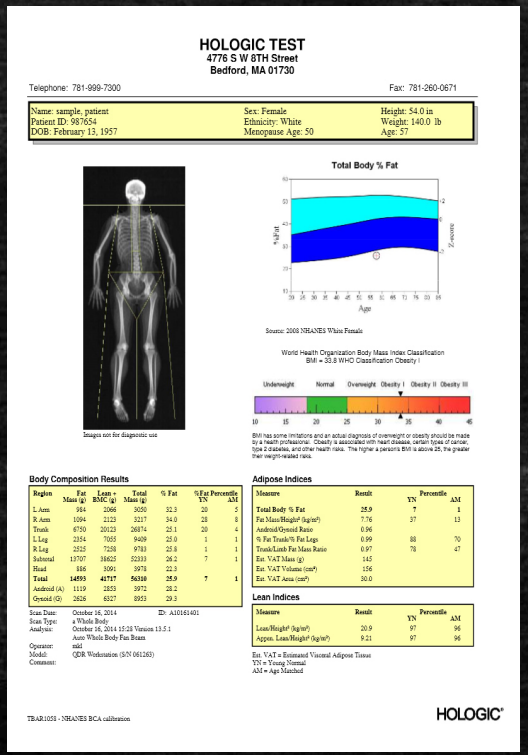
Forearm loss may be indicative of hyperparathyroidism

Roma, 8-11 novembre 2018

ITALIAN CHAPTER

TOTAL BODY

ONLY IN SELECTED PATIENTS



HOLOGIC TEST
4776 S W 8TH Street
Bedford, MA 01730

Telephone: 781-999-7300 Fax: 781-260-0671

Name: sample, patient	Sex: Female	Height: 54.0 in
Patient ID: 987654	Ethnicity: White	Weight: 140.0 lb
DOB: February 13, 1957	Menopause Age: 50	Age: 57

Images not for diagnostic use

Total Body % Fat

Source: 2008 NHANES White Female

World Health Organization Body Mass Index Classification
BMI = 33.8 WHO Classification Obesity I

Underweight Normal Overweight Obesity I Obesity II Obesity III

BMI has some limitations and an actual diagnosis of overweight or obesity should be made by a health professional. Obesity is associated with heart disease, certain types of cancer, type 2 diabetes, and other health risks. The higher a person's BMI is above 25, the greater their weight-related risks.

Body Composition Results

Region	Fat Mass (g)	Lean + BMC (g)	Total Mass (g)	% Fat	%Fat Percentile YN	%Fat Percentile AM
L Arm	984	2066	3050	32.3	20	5
R Arm	1094	2123	3217	34.0	28	8
Trunk	6750	20123	26874	25.1	20	4
L Leg	2354	7055	9409	25.0	1	1
R Leg	2525	7258	9783	25.8	1	1
Subtotal	13707	38625	52333	26.2	7	1
Head	886	3091	3978	22.3		
Total	**14593**	**41717**	**56310**	**25.9**	**7**	**1**
Android (A)	1119	2853	3972	28.2		
Gynoid (G)	2626	6527	8953	29.3		

Scan Date: October 16, 2014 ID: A10161401
Scan Type: a Whole Body
Analysis: October 16, 2014 15:28 Version 13.5.1
Auto Whole Body Fan Beam
Operator: mld
Model: QDR Workstation (S/N 061263)
Comment:

Adipose Indices

Measure	Result	Percentile YN	Percentile AM
Total Body % Fat	**25.9**	**7**	**1**
Fat Mass/Height² (kg/m²)	7.76	37	13
Android/Gynoid Ratio	0.96		
% Fat Trunk/% Fat Legs	0.99	88	70
Trunk/Limb Fat Mass Ratio	0.97	78	47
Est. VAT Mass (g)	145		
Est. VAT Volume (cm³)	156		
Est. VAT Area (cm²)	30.0		

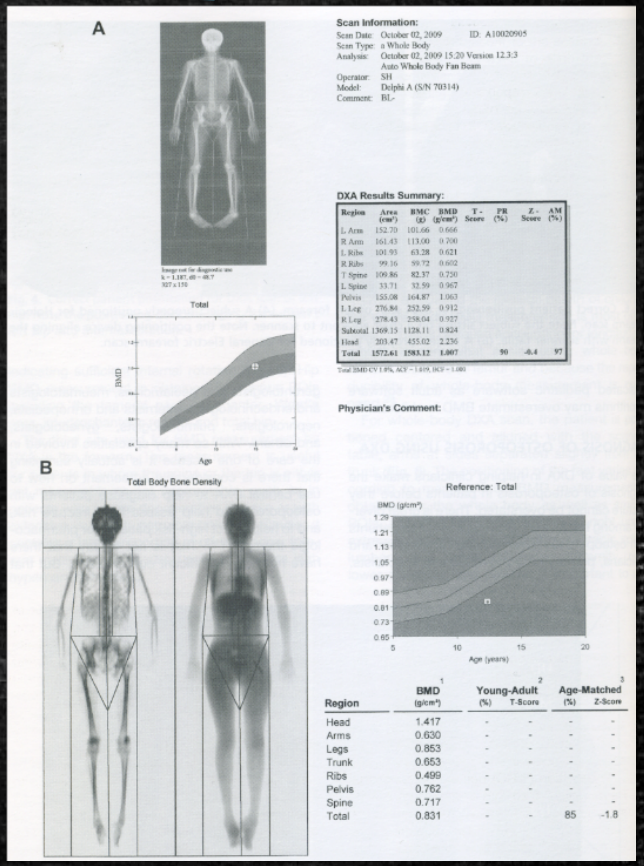
Lean Indices

Measure	Result	Percentile YN	Percentile AM
Lean/Height² (kg/m²)	20.9	97	96
Appen. Lean/Height² (kg/m²)	9.21	97	96

Est. VAT = Estimated Visceral Adipose Tissue
YN = Young Normal
AM = Age Matched

TBAR1058 - NHANES BCA calibration

HOLOGIC



A

Image not for diagnostic use
k = 1.187, dB = 48.7
327 x 150

Total

Age

B

Total Body Bone Density

Scan Information:
Scan Date: October 02, 2009 ID: A10020905
Scan Type: a Whole Body
Analysis: October 02, 2009 15:20 Version 12.3:3
Auto Whole Body Fan Beam
Operator: SH
Model: Delphi A (S/N 70314)
Comment: BL-

DXA Results Summary:

Region	Area (cm²)	BMC (g)	BMD (g/cm²)	T-Score	PR (%)	Z-Score	AM (%)
L Arm	152.70	101.66	0.666				
R Arm	161.43	113.00	0.700				
L Ribs	101.93	63.28	0.621				
R Ribs	99.16	59.72	0.602				
T Spine	109.86	82.37	0.750				
L Spine	33.71	32.59	0.967				
Pelvis	155.08	164.87	1.063				
L Leg	276.84	252.59	0.912				
R Leg	278.43	258.04	0.927				
Subtotal	1369.15	1128.11	0.824				
Head	203.47	455.02	2.236				
Total	**1572.61**	**1583.12**	**1.007**		**90**	**-0.4**	**97**

Total BMD CV 1.0%, ACV = 1.019, DCV = 1.000

Physician's Comment:

Reference: Total

Region	BMD (g/cm²) [1]	Young-Adult (%) [2]	Young-Adult T-Score	Age-Matched (%) [3]	Age-Matched Z-Score
Head	1.417	-	-	-	-
Arms	0.630	-	-	-	-
Legs	0.853	-	-	-	-
Trunk	0.653	-	-	-	-
Ribs	0.499	-	-	-	-
Pelvis	0.762	-	-	-	-
Spine	0.717	-	-	-	-
Total	0.831	-	-	85	-1.8

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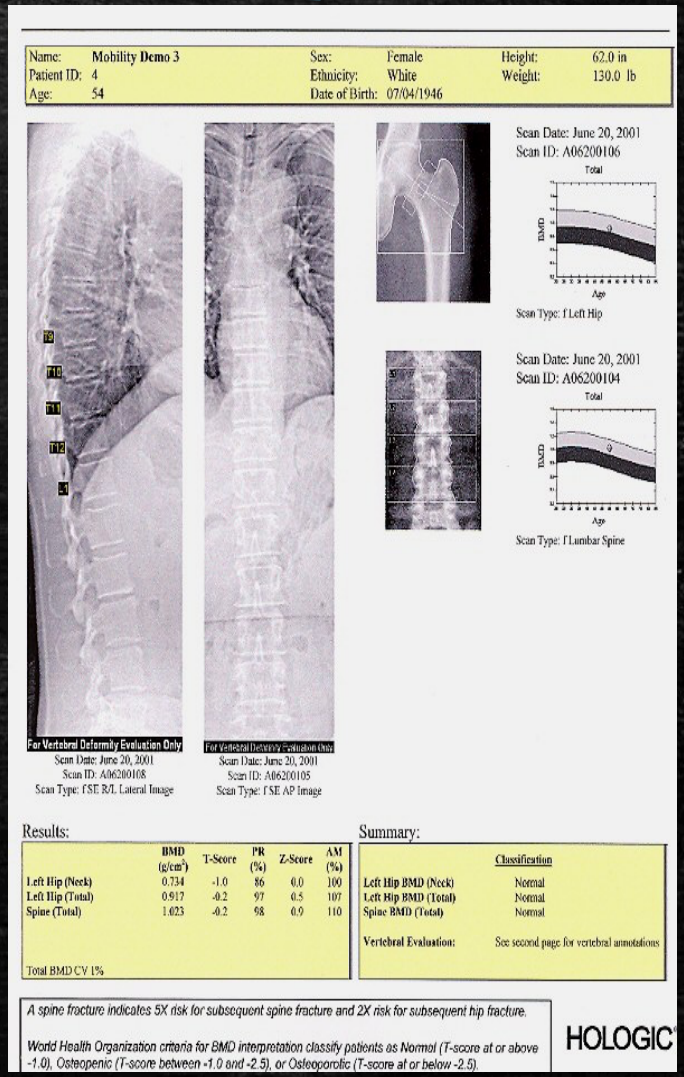
ITALIAN CHAPTER

VFA: VERTEBRAL FRACTURE ASSESSMENT

Vertebral Fracture Assessment (VFA) is the correct term to denote densitometric spine imaging performed for the purpose of detecting vertebral fractures.

- Very low radiation
- Not as good as plain film but good enought to view spine for fractures
- Not all facilities offer this
- Takes about 10-15 minutes



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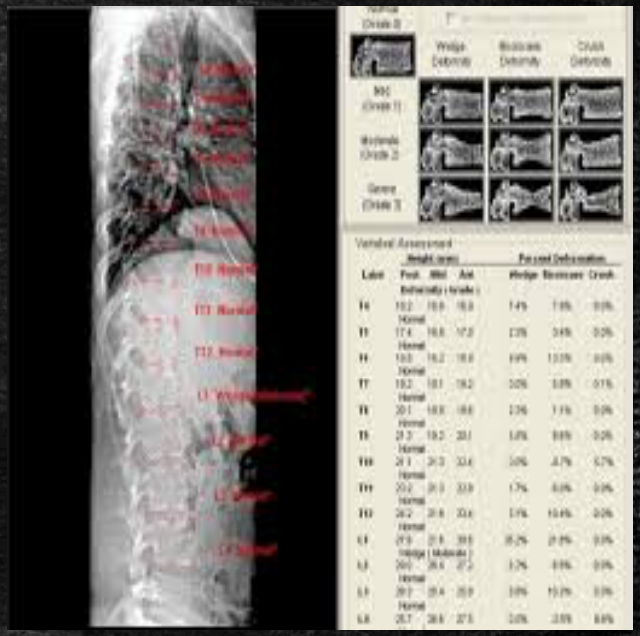
Indications for VFA

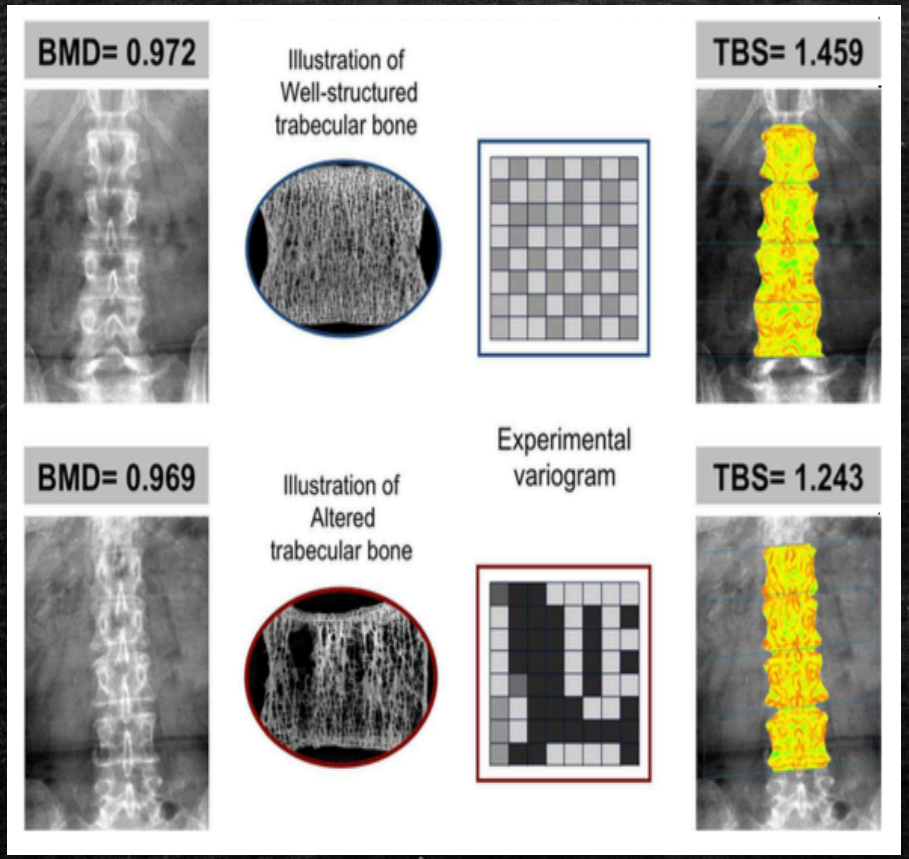
Lateral Spine imaging with Standard Radiography or Densitometric VFA is indicated when T-score is < -1.0 and of one or more of the following is present:

- Women age ≥ 70 years or men ≥ age 80 years
- Historical height loss > 4 cm (>1.5 inches)
- Self-reported but undocumented prior vertebral fracture
- Glucocorticoid therapy equivalent to ≥ 5 mg of prednisone or equivalent per day for ≥ 3 months



The decision to perform additional imaging must be based on each patient's overall clinical picture, including the VFA result.

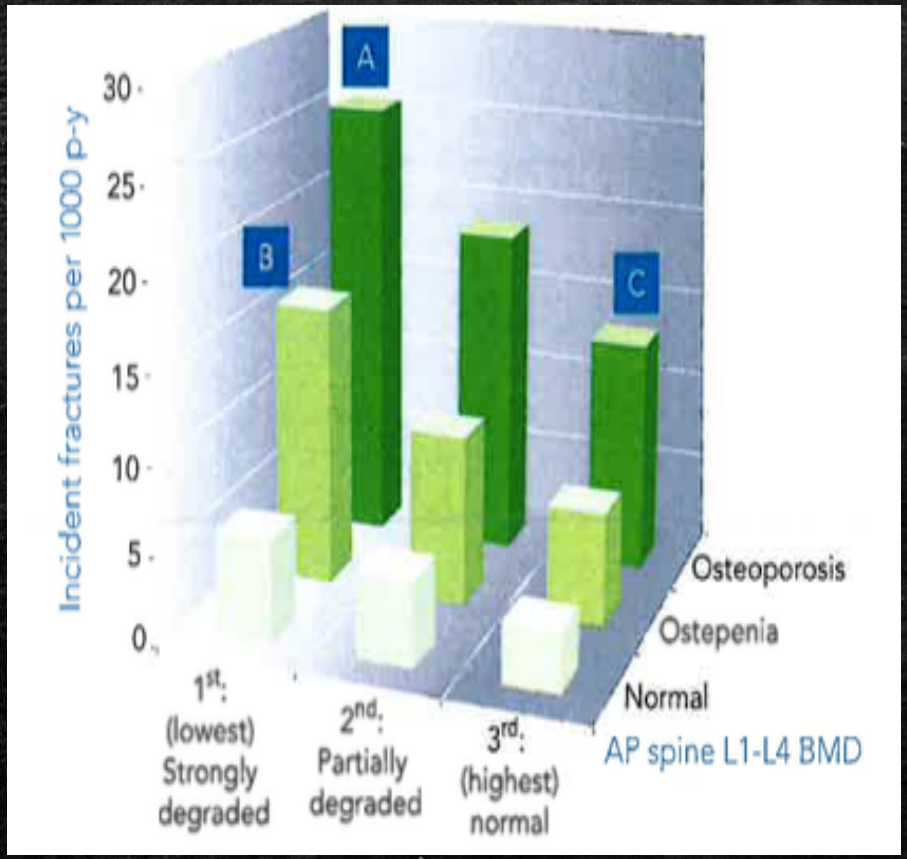
TBS
TRABECULAR BONE SCORE



is a gray-level textural metric that can be extracted from the two-dimensional lumbar spine dual-energy X-ray absorptiometry (DXA) image

TBS is undirectly related to bone microarchitecture

TBS and BMD



RISK CLASS

>1.300 - normal

1.200-1.300 - intermediate risk

<1.200 - high risk

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- is associated with vertebral, hip and major osteoporotic fracture risk in postmenopausal women

- is associated with hip fracture and with major osteoporotic fracture risk in men over the age of 50 ys

- should not be used alone to determine treatment recommendations in clinical practice

- can be used with FRAX and BMD to adjust FRAX probability of fracture in postmenopausal women or older men

- is not useful for monitoring bisphosphonate treatment in postmenopausal women with osteoporosis

- is associated with major osteoporotic fracture risk in postmenopausal women with type 2 diabetes

TRABECULAR BONE SCORE
2015 ISCD Official Position

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ITALIAN CHAPTER

WHEN DO YOU ORDER A FOLLOW-UP DEXA

- ORDER THE FOLLOW-UP WHEN YOU ANTICIPATE THAT THE LOSS OR GAIN WILL SURPASS THE LEAST SIGNIFICANT CHANGE (lsc) FOR THE DXA CENTER
- MAKE SURE THAT THE FACILITY USES ORIGINAL TEMPLATE - NO NEW ART WORK ON LUMBAR SPINE
- REQUEST THAT THE REPORT INCLUDE THE DIAGNOSTIC PAGES

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DXA REPORT: OPTIMAL ITEMS

- Recommendation for **further non BMD testing**, such as X-ray, magnetic resonance imaging, computed tomography, etc....
- Recommendations for pharmacological and non-pharmacological **interventions**
- Addition of the percentage compared to reference population
- **Specific recommendation** for evaluation of secondary osteoporosis

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DXA REPORT: ITEMS THAT SHOULD NOT BE INCLUDED

ITALIAN CHAPTER

- a statement that there is bone loss without knowledge of previous bone density.
- mention of "mild", "moderate" or "marked" osteopenia or osteoporosis
- separate diagnosis for different ROI (e.g. osteopenia at the hip and osteoporosis at the lumbar spine)
- expressions such as "she has the bone of an 80-year-old", if the patient is not 80 year-old
- results from skeletal sites that are not technically valid
- the change in BMD if it is not a significant change based on the precision error and lsc

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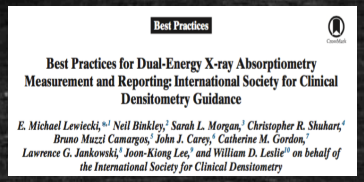
.....HAPPY ENDING....


Best Practices

Best Practices for Dual-Energy X-ray Absorptiometry Measurement and Reporting: International Society for Clinical Densitometry Guidance

E. Michael Lewiecki,[a,]* Neil Binkley,[2] Sarah L. Morgan,[3] Christopher R. Shuhart,[4] Bruno Muzzi Camargos,[5] John J. Carey,[6] Catherine M. Gordon,[7] Lawrence G. Jankowski,[8] Joon-Kiong Lee,[9] and William D. Leslie[10] on behalf of the International Society for Clinical Densitometry

SCAN ACQUISITION AND ANALYSIS

- 1.1. One practicing DXA technologist has a valid certification in bone densitometry.
- 1.2. Each DXA technologist applies manual-instruction-standards for BMD measurement.
- 1.3. Each DXA facility has detailed standard operating procedures for DXA performance.
- 1.4. The DXA facility must comply with all applicable radiation safety requirements.
- 1.5. Spine phantom BMD measurement is performed at least once weekly to document stability of DXA performance over time (BMD values tolerance of ±1.5%)
- 1.6. Each DXA technologist has performed in vivo precision assessment and the facility LSC has been calculated.
- 1.7. The LSC for each DXA technologist should not exceed
  - 5.3% for the lumbar spine
  - 5.0% for the total proximal femur
  - 6.9% for the femoral neck

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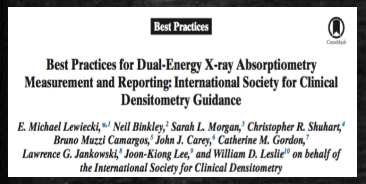
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INTERPRETATION AND REPORTING

- 2.1. At least 1 practicing DXA interpreter, and preferably all, has a valid certification in bone densitometry.
- 2.2. The DXA manufacturer and model are noted on the report.
- 2.3. The DXA report includes a statement regarding scan factors that may adversely affect acquisition/analysis quality and artifacts/confounders, if present.
- 2.4. The DXA report identifies the skeletal site, region of interest, and body side for each technically valid BMD measurement.
- 2.5. There is a single diagnosis reported for each patient, not a different diagnosis for each skeletal site measured.
- 2.6. A fracture risk assessment tool is used appropriately.
- 2.7. When reporting differences in BMD with serial measurements, only those changes that meet or exceed the LSC are reported as a change.

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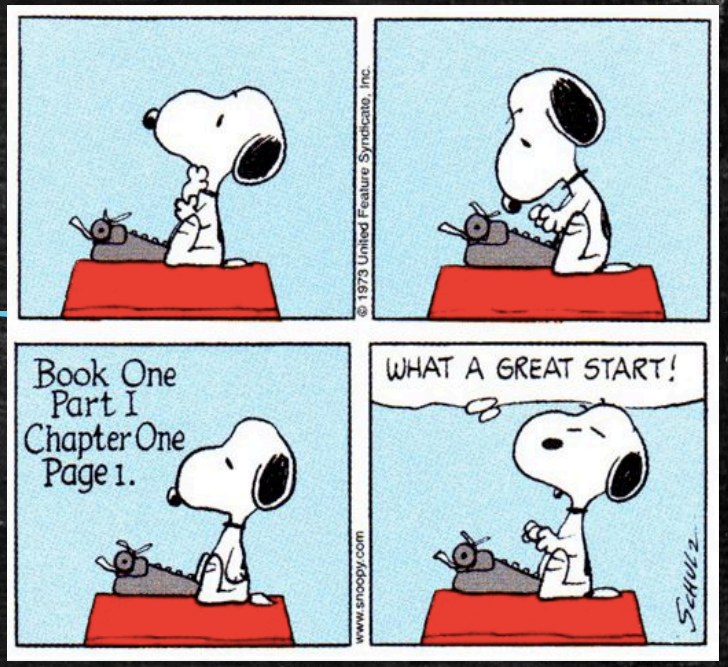
GRAZIE



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Istituto di ricovero e cura a carattere scientifico

CENTRO CLINICO E DI RICERCA DI MALATTIE METABOLICHE DELL'OSSO E DIABETOLOGIA