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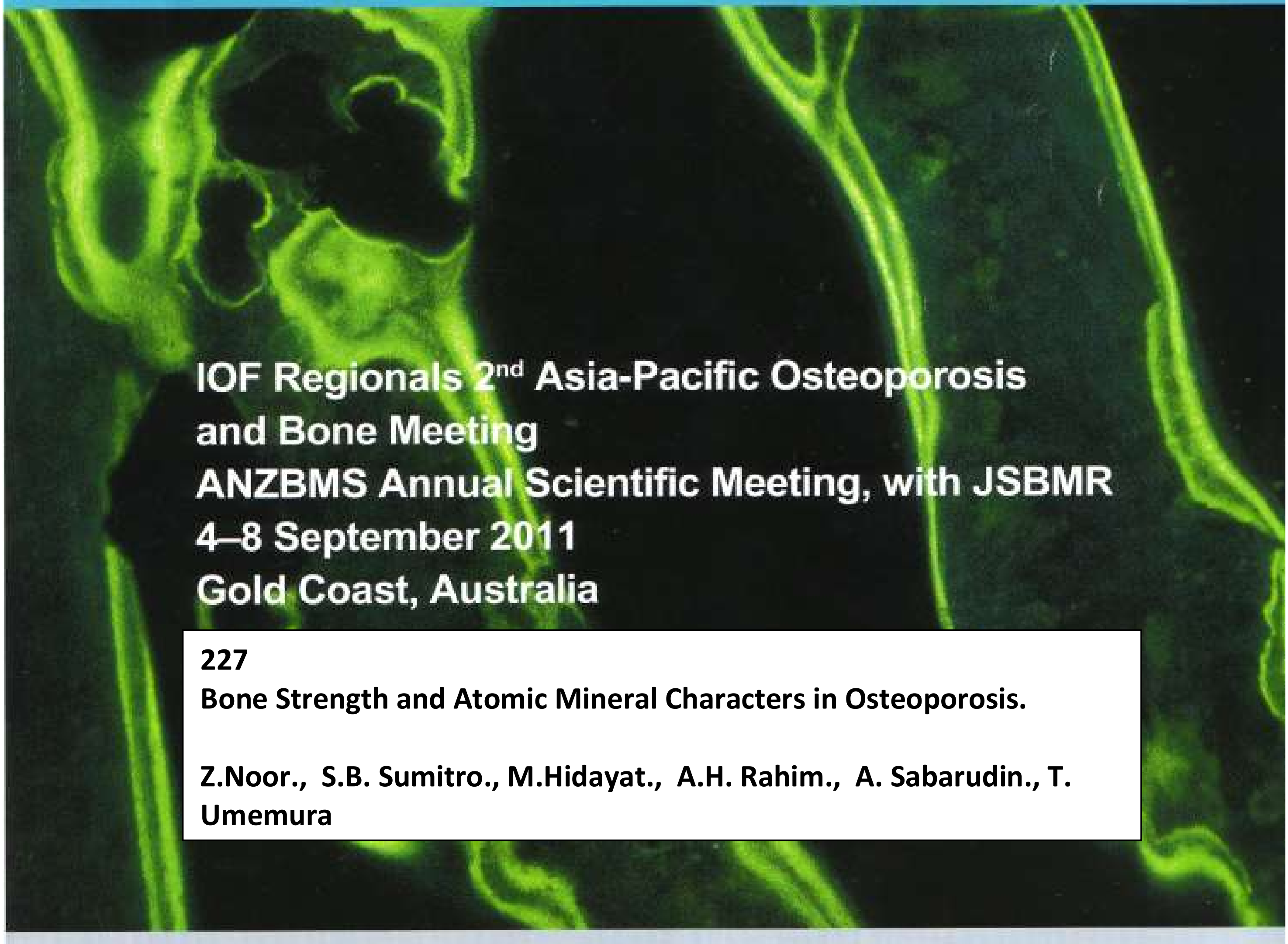
OSTEOPOROSIS INTERNATIONAL

with other metabolic bone diseases

EDITORS-IN-CHIEF JOHN A. KANIS AND ROBERT LINDSAY



IOF Regionals 2nd Asia-Pacific Osteoporosis and Bone Meeting
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Bone Strength and Atomic Mineral Characters in Osteoporosis.

Z.Noor., S.B. Sumitro., M.Hidayat., A.H. Rahim., A. Sabarudin., T. Umemura

National Osteoporosis Foundation
International Osteoporosis Foundation
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Results: Eight men, 15 women and eight children were measured. Mean ages were 28.6 y (S.D. 10.3); 27.2 y (S.D. 7.6); and 8.3 y (S.D. 2.3 y) respectively. BMD (g/cm^2) ranged from 0.979–1.214; 0.866–1.166; and 0.629–1.001, respectively.

Univariate correlation between BMD and LM was significant in women (r=0.54, P=0.04) and in children (r=0.95, P< 0.001). SMM was significantly correlated with BMD in children (r=0.98, P<0.001) but less so for adults.

When both LM and FM were entered into the regression model in women, LM was a better predictor of BMD, accounting for 29% of variance (R^2=0.289; P=0.02). In children, LM accounted for 91% of variance in BMD (R^2=0.909; P< 0.001). Our analysis failed to show similar association in men.

Conclusion: The data suggests that in our British African population, LM is a better determinant of BMD in children and adult women.

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RADIATION STERILIZATION REDUCES THE ENERGY ABSORPTION CAPACITY OF MORSELLIZED CANCELLOUS BONE ALLOGRAFTS DURING COMPACTION

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Morsellized cancellous bone allografts are commonly used in joint revision to fill bone gaps and to stabilize the implanted stem. To minimize the risk of infection, bone allografts are sterilized using gamma radiation. However, radiation also affects bone mechanical properties. Many studies are reported for radiation effects on cortical and cancellous bone allografts, but data for morsellized bone is limited. We aimed to investigate the mechanical response of morsellized cancellous bone irradiated at 15, 25 and 50 kGy using a compaction test. Ten femoral heads were processed to obtain morsellized bone samples. Bone material from each femoral head was allocated to four irradiation groups: 0, 15, 25, and 50 kGy. Morsellized bone (5 g per sample) was placed in a 14 ml aluminium tube and compacted at load of 100 N for 150 cycles by a piston attached to an Instron dual column material testing machine (3365A series) and Bluehill software was used to calculate strain, elastic modulus, and energy. Test results revealed that the difference in strain between control (0 kGy) and irradiated groups was not significant. However, the modulus of elasticity increased significantly after the 30th cycle at the low gamma dose (15 kGy, P<0.05), and after the 10th cycle for the standard dose (25 kGy) and high dose (50 kGy) groups (P< 0.01). More importantly, energy absorption (toughness) was significantly lower in all irradiated bone groups, even at early cycles compared to the control group (P<0.010). These data illustrate that morsellized bone becomes more brittle following gamma irradiation, reducing its ability to absorb energy. As a result, it is less effective as stabilizing agent in joint revision, increasing the risk of loosening following impaction grafting.

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BONE STRENGTH AND ATOMIC MINERAL CHARACTERS IN OSTEOPOROSIS

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Aim: To find relationship between bone strength (trivial and nontrivial injury) and atomic mineral characters in trabecular osteoporosis bone.

Methods: Two groups involved in this study such as trivial injury group and nontrivial injury group. Inclusion criteria consist of postmenopausal and nonmenopausal woman, trabecular bone fracture, osteoporosis BMD score, and no history of previous disease. The study was conducted in Department of Orthopedics Ulin General Hospital of Banjarmasin and Department of Orthopedics Saiful Anwar Hospital of Malang from September 2010-April 2011. Bone was obtained in surgery room then analyzed for atomic mineral characters by High Resolution Inductively Coupled Plasma Mass Spectrometry in Division of Nanomaterial Sciences, EcoTopia Science Institute, Nagoya University.

Results: Concentration of Li, Na, Mg, Al, P, K, Ca, Cr, Cu, Zn, As, Rb, Sr, Pd, Ag, Te, Ba, Pb, and Se in nontrivial injury group is higher than trivial injury group. Many references indicated that these atomic minerals have positive (synergistic) role on bone strength. Concentration of B, S, V, Mn, Fe, Co, and Ni in nontrivial injury group is lower than trivial injury group. These atomic minerals have negative (antagonistic) role on bone strength.

Conclusion: Bone trabecular strength of osteoporosis patients is in accordance with the characters of atomic composition found, indicating that these atomic minerals should be considered in any discussion related to the bone strength.

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A PHANTOM FOR DETERMINING ACCURACY OF DXA-DERIVED FEMORAL NECK STRUCTURAL GEOMETRY

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Aim: There has been an increase in the use of structural geometry, measured by DXA or QCT methods to facilitate understanding of bone fragility in the hip. However, methods for assessing the accuracy of structural geometric methods are lacking. This study reports the development of a 3D anthropometric proximal femoral phantom for calibration of measurements of femoral neck structural geometry variables derived from DXA scans.

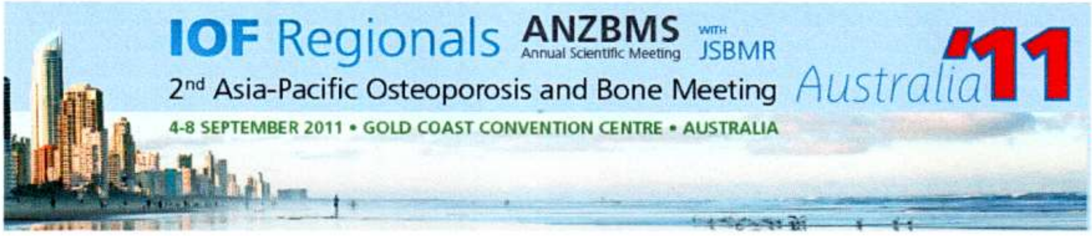
Methods: An anthropometric phantom was constructed from materials that radiologically simulate trabecular and cortical bone. It consisted of a femoral shaft and head, plus seven interchangeable neck modules varying in size and shape, to span the range of geometries commonly observed in the necks of adult femurs; from a cortical thickness of 0.7 mm defining a circular annulus (Module 1) to thicknesses of 3 and 8 mm in an asymmetric elliptical cross-section (Module 7). The phantom was scanned (each module ten times) in a water bath using an Hologic Discovery DXA scanner in hip-array mode; the data then analysed using hip structural analysis (HSA) software (QMM).

Results: All DXA-derived structural geometric variables were very highly correlated ($r \sim 1.00$) with the equivalent 'gold-standard' values derived from the phantom's known physical properties (shape and composition). Though systematic errors were up to 98%, these high correlations validate the use of the phantom as an accuracy calibration tool. Linear predictive equations were generated for each variable (exponential for buckling ratio [BR]), then used to predict the 'correct' values derived from DXA. After this calibration was applied, maximum accuracy errors for DXA measurements on the module with the thinnest cortex (1) ranged from −22% for average cortical thickness (aCt) to +6% for areal (a) BMD. All variables in other modules showed a maximum accuracy error of 5%, with most values <3%. The Table summarises correlations and percentage (%) differences between calculations of structural geometric variables based on phantom physical properties and corresponding DXA-based HSA measurements for aBMD, cross-sectional area (CSA), cross-sectional moment of inertia (CSMI), outer diameter (OD), section modulus (Z), estimated aCt and BR, following calibration. The pre-calibration value is in parentheses.

Conclusions: Accuracy errors were largest for measurements of aCT, Z and aBMD in the femoral neck module with the thinnest cortex (0.7 mm), but acceptable for other geometrical variables, plus generally all variables in the other modules with progressively thicker cortices.

Table: DXA-derived structural geometrical accuracy, expressed as % difference from direct phantom calculations, following adjustment for the precalibration value in parentheses*

	aBMD	*CSA*	*CSMI*	*OD*	*Z*	*aCt*	BR
Module 1	6(16)	4(18)	−3(23)	−1(1)	5(19)	−22(30)	−1(−20)
Module 2	2(8)	3(10)	4(7)	<1(1)	−1(3)	1(−6)	4(11)
Module 3	*−3(1)*	*−2(1)*	*<1(−4)*	*<1(<1)*	*2(2)*	*<1(−26)*	*−1(26)*
Module 4	3(−2)	−2(−2)	1(−10)	<1(<1)	<1(−4)	4(−37)	−1(49)
Module 5	−1(−2)	−1(−3)	−2(−15)	<1(−1)	−3(−8)	5(−43)	−3(63)
Module 6	−1(−3)	<1(−4)	<1(−17)	<1(−2)	−2(−10)	1(−50)	1(83)
Module 7	*2(−1)*	*1(−5)*	*<1(−19)*	*−1(−3)*	*2(−8)*	*−3(−56)*	*1(98)*
Correl (r)	1.00	1.00	1.00	1.00	1.00	1.00	1.00



International Osteoporosis Foundation

ANZBMS

5th September 2011

This is to certify that

Zairin Noor

Attended the **2011 IOF Regional - 2nd Asia-Pacific Osteoporosis and Bone Meeting held in conjunction with the ANZBMS Annual Scientific Meeting and JSBMR**. The meeting was held at the Gold Coast Convention Centre in Broadbeach, Queensland from the Sunday 4th - Thursday 8th September 2011.

Kind Regards,

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BONE STRENGTH AND ATOMIC MINERAL CHARACTERS IN OSTEOPOROSIS

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Background

- Bone consist of organic and anorganic component (Zioupos et al, 2008).
- Several of atomic mineral was found in bone, such as Ca, P, Mg, F, Fe, Na, Zn, Al, Cd, Sr, Cu, Mn, Si, and Pb (Illich & Kerstetner, 2000; Beattie & Avenell, 1992; Scancar et al, 2000).
- Substitution or incorporation of atomic mineral determine bone properties (Vallet-Regi & Arcos, 2008).

Aims

To find relationship between bone strength (trivial and non trivial injury) and atomic mineral characters in trabecular osteoporosis bone.

Methods

- Setting:

  Department of Orthopedic, Ulin General Hospital, Banjarmasin and Department of Orthopedic, Saiful Anwar General Hospital, Malang.
- Trivial injury and non trivial injury group.
- Inclusion criteria: post menopausal and non menopausal women, osteoporosis bone mineral density score, no history of previous disease.
- Bone was obtained in surgery room then analysed for atomic mineral characters by High Resolution Inductively Coupled Plasma Mass Spectrometry in Division of Nanomaterial Sciences, EcoTopia Science Institute, Nagoya University, Japan.

Results

Atomic minerals have positive (synergistic) role in bone strength									
Li	Na	Mg	Al	P	K	Ca	Cr	Cu	Zn
As	Rb	Sr	Pd	Ag	Te	Ba	Pb	Se	

Atomic minerals have negative (antagonistic) role in bone strength						
B	S	V	Mn	Fe	Co	Ni

Discussion

Functions	Atomic mineral
Hydroxyapatite crystal structure	Ca, P, Mg, Sr, As, Pb, B, Mn,
Enzymatic cofactor	Cr, Cu, Zn
Neo-osteogenesis	Mg, Al
Metabolic	Na
Organic structure	Se, S
Toxic for osteoblast	V, Fe, Co, Ni
Unknown	Li, Rb, Pd, Ag, Te

Noor *et al*, 2011

Conclusion

Bone trabecular strength of osteoporosis patients is accordance with the characters of atomic composition found, indicating that these atomic minerals should be considered in any discussion related to the bone strength.

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