Osteoporos Int (2004) 15: 779–784
DOI 10.1007/s00198-004-1677-3

POSITION PAPER

Special report on the official positions of the International Society for Clinical Densitometry

**E.M. Lewiecki · D.L. Kendler · G.M. Kiebzak
P. Schmeer · R.L. Prince · G. El-Hajj Fuleihan
D. Hans**

Received: 10 May 2004 / Accepted: 12 May 2004 / Published online: 20 July 2004

Abstract The International Society for Clinical Densitometry (ISCD) periodically holds Position Development Conferences (PDCs) for the purpose of establishing standards and guidelines for indications, acquisition, and interpretation of bone density tests. Topics are selected for consideration by the ISCD Scientific Advisory Committee, reviewed by scientific working groups, and presented to an international panel of experts. Topic categories addressed to date include indications for bone density testing, selection of reference databases for T-scores and Z-scores, clinical applications for central and peripheral bone densitometry, serial bone density testing, instrument precision assessment, phantom scanning and calibration testing, requirements for a bone density report, nomenclature, and diagnosis of osteoporosis in postmenopausal women, premenopausal women, men, and children. Following an open session for public comment and discussion, the panel convenes for consideration of each topic and makes recommendations for positions to the ISCD Board of Directors. Recommendations that are accepted become the Official Positions of the ISCD. This Special Report summarizes the methodology of the ISCD PDCs and presents selected Official Positions of general interest.

Keywords BMD · Bone densitometry · Bone mineral density · Guidelines · Osteoporosis · Positions · Standards

A list of the 2003 Position Development Conference Expert Panel members, Working Group members, and sponsors appears at the end of this article. The complete ISCD position papers were published in 2004 (J Clin Densitom 7:1–63). A summary of the ISCD Official Positions has been accepted for publication by the *Journal of Clinical Endocrinology and Metabolism*.

E.M. Lewiecki (✉)
New Mexico Clinical Research & Osteoporosis Center,
300 Oak Street NE, Albuquerque,
NM87106, USA
E-mail: LEWIECKI@aol.com
Tel.: +44-505-9382117
Fax: +44-505-8844006

R.L. Prince
University of Western Australia, Nedlands,
Western Australia, Australia

G. El-Hajj Fuleihan
American University of Beirut, Beirut,
Lebanon

D. Hans
Geneva University Hospital, Geneva,
Switzerland

D.L. Kendler
University of British Columbia, Vancouver,
B.C., Canada

G.M. Kiebzak
St. Luke's Episcopal Hospital, Houston,
Tex., USA

P. Schmeer
Northwest Bone Densitometry Consultants,
Renton, Wash., USA

Introduction

The ISCD is an independent not-for-profit multidisciplinary professional society with a mission to enhance knowledge and quality of bone densitometry among healthcare professionals, to provide continuing education courses for clinicians and technologists, to increase patient awareness and access to bone densitometry, and to support clinical and scientific advances in the field. With the increasing use of bone density testing for diagnosing osteoporosis and establishing fracture risk, inconsistencies have arisen in the way in which bone densitometry is performed and the results interpreted. These inconsistencies, which may have adverse effects on patient care and the exchange of scientific information, include differences in the indications for bone density testing, interpretation of results, methods of reporting and terminology. To mitigate these inconsistencies and improve interpretation and reporting of bone mineral density, the ISCD periodically convenes PDCs.

Methodology

Topics were selected for presentation at the PDC based on clinical relevance, current lack of guidelines, and likelihood of achieving agreement. Each topic was reviewed by members of the ISCD Scientific Advisory Committee (SAC), beginning with a literature search using a method modified from that used for Cochrane reviews [1]. Searches for each topic, except indications for bone density testing, were conducted using MEDLINE, PubMed, and EMBASE databases. Appropriate articles were identified for further review and analysis by the SAC. Concurrently with these activities, a group of experts in the field of pediatric densitometry were developing a series of recommendations for bone density testing in children. All findings were presented to an international panel of experts in bone densitometry. After receiving comments from clinicians, technologists, and industry experts at a public forum, the panel members discussed each topic and make recommendations to the ISCD Board of Directors. Those that were approved became "Official Positions" of the ISCD. The most recent PDC was held in Cincinnati, Ohio, on July 25–27, 2003. The PDC was supported in part by unrestricted grants from industry, which had no role in the decisions of the panel and the ISCD Board of Directors, and no role in the writing or editing of papers published in peer-reviewed journals. The complete review of the background and rationale for all ISCD Official Positions is published in the *Journal of Clinical Densitometry* [2,3,4,5,6,7,8,9,10,11,12,13,14].

Indications for bone density testing

Although dual-energy X-ray absorptiometry (DXA) is widely used to measure bone mineral density (BMD), there are few guidelines regarding indications for testing in populations other than postmenopausal women. The ISCD has established comprehensive indications for bone density testing that consider all adults.

Bone density testing should be done for the following individuals: women aged 65 and older; postmenopausal women under age 65 with risk factors; men aged 70 and older; adults with a fragility fracture; adults with a disease or condition associated with low bone mass or bone loss; adults taking medications associated with low bone mass or bone loss; anyone being considered for pharmacologic therapy; anyone being treated, to monitor treatment effect; and anyone not receiving therapy in whom evidence of bone loss would lead to treatment.

Women discontinuing estrogen should be considered for bone density testing according to the indications listed above.

The National Osteoporosis Foundation has identified many of the risk factors for osteoporosis and related fractures in white postmenopausal women [15]. Major risk factors are personal history of fracture as an adult, history of fragility fracture in a first degree relative, low body weight (about 57.7 kg or 127 lb), current smoking and use of oral glucocorticoid therapy for more than 3 months. Additional risk factors are impaired vision, estrogen deficiency at an early age (<45 years), dementia, poor health/frailty, recent falls, low calcium intake (lifelong), low physical activity, and alcohol in amounts more than 2 drinks per day. Medical conditions associated with increased risk of osteoporosis include chronic obstructive pulmonary disease, gastrectomy, hyperparathyroidism, hypogonadism, multiple myeloma, and celiac disease. Medications, in addition to oral glucocorticoids, that are associated with reduced bone mass in adults include anticonvulsants, gonadotropin releasing hormone agonists, excessive thyroxine doses, and lithium. As with any test in clinical practice, bone density testing should only be done when it is likely to play a role in patient management decisions. For example, in a patient being considered for pharmacologic therapy, a bone density test would assume such a role if the results would aid in the decision to start or not start medication, assist in the selection of the type of drug, or provide a baseline measurement for monitoring the effects of therapy. The US Preventive Services Task Force, which only addressed postmenopausal women, also recommends that bone density testing be done for women aged 65 and older, and for women aged 60 and older at increased risk for osteoporotic fractures [16].

Central DXA for diagnosis

Measurement of BMD by DXA is the "gold standard" method for the non-invasive diagnosis of osteoporosis [17,18,19,20]. The World Health Organization (WHO) classification of BMD for the diagnosis of osteoporosis is based on the number of standard deviations that the measured BMD of the hip, lumbar spine, or forearm varies from the mean BMD of a young-adult reference population [21]. The WHO did not specify how many skeletal sites to measure or which region(s) of interest within a skeletal site should be used for diagnosis. These issues are addressed in the following statements.

Skeletal sites to measure

Measure BMD at both PA spine and hip in all patients.

Forearm BMD should be measured under the following circumstances: hip and/or spine cannot be measured or interpreted; hyperparathyroidism; very obese patients (over the weight limit for DXA table).

Spine region of interest

Use PA L1–L4 for spine BMD measurement.

Use all evaluable vertebrae and only exclude vertebrae that are affected by local structural change or

artifact. Use three vertebrae if four cannot be used and two if three cannot be used.

Lateral spine should not be used for diagnosis, but may have a role in monitoring.

Spine BMD should be interpreted with caution in the elderly, since degenerative arthritis in the posterior elements of the spine may result in an artifactual increase in measured BMD. If there are significant structural abnormalities in the spine, then BMD should be measured at the hip and forearm.

Hip region of interest

Use total proximal femur, femoral neck, or trochanter, whichever is lowest.

BMD may be measured at either hip.

Do not use Ward's area for diagnosis.

There are insufficient data to determine whether mean T-scores for bilateral hip BMD can be used for diagnosis.

The mean hip BMD can be used for monitoring, with total hip being preferred.

Forearm region of interest

Use 33% radius (sometimes called one-third radius) of the non-dominant forearm for diagnosis. Other forearm regions of interest are not recommended.

Peripheral bone densitometry

Many studies have shown that bone mineral density measurements at peripheral skeletal sites can be used to assess the risk of fracture at the spine, hip, and non-vertebral sites in postmenopausal White women [22]. The relative risk for such fractures averages approximately 1.5 for each standard deviation decrease in BMD below the mean BMD of the reference population. The concordance between prevalence of osteoporosis and lifetime fracture risk that has been observed using central skeletal sites and a T-score cutoff of −2.5 has not been rigorously demonstrated with peripheral BMD measured with a variety of technologies [23]. Clinical trials examining the effect of antiresorptive agents on BMD have not found changes in BMD or ultrasound parameters at any peripheral site that exceed the least significant change [24]. The following statements represent the current state of knowledge for clinical applications of peripheral BMD testing.

The World Health Organization (WHO) classification for diagnosis of osteoporosis and osteopenia should not be used with peripheral BMD measurement other than 33% radius.

Peripheral measurements:

- are useful for assessment of fracture risk.
- theoretically can be used to identify patients unlikely to have osteoporosis and identify patients who should be treated; however, this cannot be applied in clinical practice until device-specific cut-points are established.
- should not be used for monitoring.

Densitometric diagnosis of osteoporosis

The WHO classification of BMD for the diagnosis of osteoporosis is founded on extensive cross-sectional data in postmenopausal White women showing a consistent correlation between BMD measured by DXA and lifetime fracture risk. Since the relationship between BMD and fracture risk is much less clear in other populations, the validity of diagnosing osteoporosis based on *T*-score alone becomes more tenuous. These issues were considered in establishing the following positions on diagnosing osteoporosis in postmenopausal women, men, premenopausal women, and children.

Diagnosis in postmenopausal women

The WHO classification (normal, T-score –1.0 or above; osteoporosis, T-score –2.5 or below; osteopenia, T-score between –1.0 and –2.5) should be used.

The lowest T-score of PA spine, femoral neck, total hip, trochanter, or the 33% radius, if measured, should be selected.

Diagnosis in men (age 20 and older)

The WHO classification should not be applied in its entirety to men.

In men age 65 and older, T-scores should be used and osteoporosis diagnosed if the T-score is at or below –2.5.

In men from age 50 to 65 years, T-scores may be used and osteoporosis diagnosed if both the T-score is at or below –2.5 and other risk factors for fracture are identified.

Men at any age with secondary causes of low BMD (e.g. glucocorticoid therapy, hypogonadism, hyperparathyroidism) may be diagnosed clinically with osteoporosis supported by findings of low BMD.

The diagnosis of osteoporosis in men under age 50 years should not be made on the basis of densitometric criteria alone.

Diagnosis in premenopausal women (age 20 to menopause)

The WHO classification should not be applied to healthy premenopausal women.

Z-scores rather than T-scores should be used.

Osteoporosis may be diagnosed if there is low BMD with secondary causes (e.g. glucocorticoid therapy,

hypogonadism, hyperparathyroidism) or with risk factors for fracture.

The diagnosis of osteoporosis in premenopausal women should not be made on the basis of densitometric criteria alone.

In premenopausal white women, the age-matched Z-score and the young-adult-matched T-score are likely to be identical or very similar. Discordance between T-scores and Z-scores may occur when there are differences in ethnicity in the reference databases used. If a black premenopausal woman has her T-score calculated using a white female reference database, according to established ISCD positions [2], and her Z-score calculated using a black female reference database, the result may be a Z-score that is significantly lower than the T-score. For example, while a 30-year-old white woman with low BMD could have a Z-score of −2.3 and a T-score −2.3 (using a white female reference database for both), a black woman the same age with a Z-score of −2.3 (using a black female reference database) might have a T-score of −1.3 (using a white female reference database). The use of Z-score instead of T-score in premenopausal women serves to emphasize the point that the WHO criteria for BMD classification do not apply, and provides a comparison of the patient's BMD with a similar population.

Diagnosis in children (males or females less than age 20)

The WHO classification should not be applied to children.

T-scores should not be used in children; Z-scores should be used instead.

T-scores should not appear in reports or on DXA printouts in children.

The diagnosis of osteoporosis in children should not be made on the basis of densitometric criteria alone.

Terminology such as "low bone density for chronologic age" may be used if the Z-score is below –2.0.

Z-scores must be interpreted in the light of the best available pediatric databases of age-matched controls. The reference database should be cited in the report.

Spine and total body are the preferred skeletal sites for measurement.

The value of BMD to predict fractures in children is not clearly determined.

There is no agreement on standards for adjusting BMD or bone mineral content (BMC) for factors such as bone size, pubertal stage, skeletal maturity, and body composition. If adjustments are made, they should be clearly stated in the report.

Serial BMD studies should be done on the same machine using the same scanning mode, software, and analysis when appropriate. Changes may be required with growth of the child.

Any deviation from standard adult acquisition protocols, such as use of low-density software and manual adjustment of region of interest, should be stated in the report.

DXA nomenclature

The medical literature and common clinical usage abounds with inconsistencies in bone densitometry terminology. Communication with colleagues and patients will be facilitated by the universal adoption of the following:

- DXA, not DEXA.
- T-score—not *T* score, *t*-score, or *t* score
- Z-score—not *Z* score, *z*-score, or *z* score

Summary

The ISCD periodically holds Position Development Conferences for the purpose of establishing standards in the field of bone densitometry. The ISCD Official Positions on indications for bone density testing, clinical applications for central and peripheral bone densitometry, diagnosis of osteoporosis in men, premenopausal women, and children, and nomenclature are presented here. All of the ISCD Official Positions are published in the *Journal of Clinical Densitometry* [2,3,4,5,6,7,8,9,10,11,12,13,14] and online at the ISCD website (www.iscd.org) as a text file and downloadable slide presentation.

ISCD Position Development Conference, Cincinnati, Ohio, USA, July 25–27, 2003

Expert Panel Members: John P. Bilezikian MD, College of Physicians & Surgeons, Columbia University, New York, N.Y., USA; Nancy Fagan RT (BD), CDT, Arizona Rheumatology Center, Phoenix, Ariz., USA; Ghada El-Hajj Fuleihan MD, American University of Beirut, Beirut, Lebanon; Didier B. Hans PhD, Geneva University Hospital, Geneva, Switzerland; Conrad C. Johnson Jr MD, Indiana University School of Medicine, Indianapolis, Ind., USA; Gary M. Kiebzak PhD, St Luke's Episcopal Hospital, Houston, Tex., USA; Andrew J. Laster MD, Arthritis and Osteoporosis Consultants of the Carolinas, Charlotte, N.C., USA; Michael R. McClung MD, Oregon Osteoporosis Center, Portland, Ore., USA; Paul D. Miller MD, Colorado Center for Bone Research, Lakewood, Col., USA; Richard L. Prince MD, University of Western Australia, Nedlands, Australia; John A. Shepherd PhD, University of California at San Francisco, San Francisco, Calif., USA; Richard D. Wasnich MD, Hawaii Osteoporosis Center, Honolulu, Hawaii, USA; Nelson B. Watts MD, University of Cincinnati Bone Health and Osteoporosis Center, Cincinnati, Ohio, USA.

Conference Co-chairs: Edward S. Leib MD, University of Vermont College of Medicine, Burlington, Vt., USA; Neil C. Binkley MD, University of Wisconsin-

Madison, Madison, Wisc., USA; Ronald C. Hamdy MD, East Tennessee State University, Johnson City, Tenn., USA; E. Michael Lewiecki MD, New Mexico Clinical Research & Osteoporosis Center, Albuquerque, New Mexico, USA.

Working Group for Diagnosis of Osteoporosis in Men, Premenopausal Women, and Children: David L. Kendler MD (Chair), University of British Columbia, Vancouver, B.C., Canada; Jan Bruder MD, University of Texas, San Antonio, Tex., USA; Gary W. Edelson MD, Associated Endocrinologists, West Bloomfield, Mich., USA; Ignac Fogelman BSc, MD, Guy's Hospital, London, UK; Ghada El-Hajj Fuleihan MD, American University of Beirut, Beirut, Lebanon; Didier B. Hans PhD, Geneva University Hospital, Geneva, Switzerland; Aliya Khan MD, McMaster University, Hamilton, Ont., Canada; Brian C. Lentle MD, University of British Columbia, Saanichton, B.C., Canada.

Pediatric DXA Guidelines Project: Laura Bachrach MD (Chair), Stanford University School of Medicine, Stanford, Calif., USA; Ellen B. Fung PhD, RD, Children's Hospital and Research Center, Oakland, Calif., USA; Aenor J. Sawyer MD, pediatric orthopedic surgeon, private practice, Oakland, Calif., USA.

Working Group for Technical Standardization for DXA: Gary M. Kiebzak, PhD (Co-chair), St Luke's Episcopal Hospital, Houston, Tex., USA; Peg Schmeer BS, CDT (Co-chair), Northwest Bone Densitometry Consultants, Renton, Wash., USA; Mary M. Checkovich MS, CDT, University of Wisconsin Hospital & Clinic, Madison, Wisc., USA; Satvinder Singh Dhaliwal MSc, CDT, Curtin University, Perth, Australia; Nancy Fagan RT (BD), CDT, Arizona Rheumatology Center, Phoenix, Ariz., USA; Harry K. Genant MD, PhD, University of California at San Francisco, San Francisco, Calif., USA; Larry G. Jankowski CDT, Illinois Bone and Joint Institute, Morton Grove, Ill., USA; Bradford J. Richmond MD, Cleveland Clinic Foundation, Cleveland, Ohio, USA; Elliot N. Schwartz MD, Foundation for Osteoporosis Research and Education, Oakland, Calif., USA.

Working Group for Indications for DXA: Neil C. Binkley MD, University of Wisconsin-Madison, Madison, Wisc., USA, and the ISCD Scientific Advisory Committee.

Working Group for DXA Reporting and Vertebral Fracture Assessment: Oscar S. Gluck MD (Chair), Arizona Rheumatology Center, Phoenix, Ariz., USA; Michael J. Maricic MD (Co-chair), Southern Arizona VA Health Care System, Tucson, Ariz., USA; Susan L. Greenspan MD, University of Pittsburgh Medical Center, Pittsburgh, Pa., USA; Michael Kleerekoper MD, Wayne State University, Detroit, Mich., USA; Sergio Ragi Eis MD, Ortopedia-Doencas Osteometabolicas, Praia Do Canto, Brazil; Donna M. Landis RN, CDT, Osteoporosis D & M Center, Laurel, Md., USA.

Working Group for Nomenclature and Decimal Places in Bone Densitometry: Robert W. Downs Jr MD (Chair), Virginia Commonwealth University, Richmond, Va., USA; Anthony B. Hodsman MD, St Joseph's Health Centre, London, Ont., Canada; Akira Itabashi MD, Saitama Medical School, Moroyama, Japan; John A. Shepherd PhD, University of California at San Francisco, San Francisco, Calif., USA; Rogene Tesar PhD, CDT, Endocrinology Thyroid & Osteoporosis Center, Austin, Tex., USA.

Sponsors: The Alliance for Better Bone Health (Procter & Gamble Pharmaceuticals and Aventis Pharmaceuticals); Eli Lilly & Company; GE Medical Systems LUNAR; Hologic, Inc.; Merck Human Health.

References

1. Cochrane Reviews Handbook. 4.1.5. 2002. Update Software, Oxford
2. Binkley NC, Schmeer P, Wasnich RD, Lenchik L (2002) What are the criteria by which a densitometric diagnosis of osteoporosis can be made in males and non-Caucasians? J Clin Densitom 5:S39–S45
3. Hamdy RC, Petak SM, Lenchik L, International Society for Clinical Densitometry Position Development Panel and Scientific Advisory Committee (2002) Which central dual X-ray absorptiometry skeletal sites and regions of interest should be used to determine the diagnosis of osteoporosis? J Clin Densitom 5:S11–S18
4. Leib ES, Lenchik L, Bilezikian JP, Maricic MJ, Watts NB (2002) Position statements of the International Society for Clinical Densitometry: methodology. J Clin Densitom 5:S5–10
5. Leib ES, Lewiecki EM, Binkley N, Hamdy RC (2004) Official positions of the International Society for Clinical Densitometry. J Clin Densitom 7:1–6
6. Lenchik L, Leib ES, Hamdy RC, Binkley NC, Miller PD, Watts NB (2002) Executive summary International Society for Clinical Densitometry position development conference Denver, Colorado July 20–22, 2001. J Clin Densitom 5:S1–S3
7. Lenchik L, Kiebzak GM, Blunt BA, International Society for Clinical Densitometry Position Development Panel and Scientific Advisory Committee (2002) What is the role of serial bone mineral density measurements in patient management? J Clin Densitom 5:S29–S38
8. Miller PD, Njeh CF, Jankowski LG, Lenchik L, International Society for Clinical Densitometry Position Development Panel and Scientific Advisory Committee (2002) What are the standards by which bone mass measurement at peripheral skeletal sites should be used in the diagnosis of osteoporosis? J Clin Densitom 5:S39–S45
9. The Writing Group for the International Society for Clinical Densitometry Position Development Conference 2004 (2004) International Society for Clinical Densitometry Position Development Conference. Nomenclature and decimal places in bone densitometry. J Clin Densitom 7:45–50
10. The Writing Group for the International Society for Clinical Densitometry Position Development Conference 2004 (2004) International Society for Clinical Densitometry Position Development Conference. Indications and reporting for dual-energy X-ray absorptiometry. J Clin Densitom 7:37–44
11. The Writing Group for the International Society for Clinical Densitometry Position Development Conference 2004 (2004) International Society for Clinical Densitometry Position Development Conference. Technical standardization for dual-energy X-ray absorptiometry. J Clin Densitom 7:27–36
12. The Writing Group for the International Society for Clinical Densitometry Position Development Conference 2004 (2004) International Society for Clinical Densitometry Position Development Conference. Diagnosis of osteoporosis in men, premenopausal women, and children. J Clin Densitom 7:17–26

13. The Writing Group for the International Society for Clinical Densitometry Position Development Conference 2004 (2004) International Society for Clincial Densitometry Position Development Conference. Introduction, methods, and participants. J Clin Densitom 7:13–6
14. The Writing Group for the International Society for Clinical Densitometry Position Development Conference 2004 (2004) Executive Summary: International Society for Clinical Densitometry Position Development Conference. J Clin Densitom 7:7–12
15. National Osteoporosis Foundation (2003) Physician's guide to prevention and treatment of osteoporosis. National Osteoporosis Foundation, Washington D.C.
16. US Preventive Services Task Force (2002) Screening for osteoporosis in postmenopausal women: recommendations and rationale. Ann Int Med 137:526–528
17. Delmas PD (2000) Do we need to change the WHO definition of osteoporosis? Osteoporos Int 11:189–191
18. Kanis JA, Gluer CC (2000) An update on the diagnosis and assessment of osteoporosis with densitometry. Committee of Scientific Advisors, International Osteoporosis Foundation. Osteoporos Int 11:192–202
19. Kanis JA, Johnell O, Oden A, Jonsson B, De Laet C, Dawson A (2000) Risk of hip fracture according to the World Health Organization criteria for osteopenia and osteoporosis. Bone 27:585–590
20. Sandrick K (1998) DXA remains gold standard for assessing spine and femoral head. Diagn Imaging (San Francisco) Suppl Bone Mass:8–11
21. Kanis JA (1994) Assessment of fracture risk and its application to screening for postmenopausal osteoporosis: synopsis of a WHO report. WHO Study Group. Osteoporos Int 4:368–381
22. Marshall D, Johnell O, Wedel H (1996) Meta-analysis of how well measures of bone mineral density predict occurrence of osteoporotic fractures. BMJ 312:1254–1259
23. Melton LJ, III (1995) How many women have osteoporosis now? J Bone Miner Res 10:175–177
24. Bonnick SL, Johnston CC Jr, Kleerekoper M, Lindsay R, Miller P, Sherwood L, Siris E (2001) Importance of precision in bone density measurements. J Clin Densitom 4:105–110