

SPECIAL APPLICATIONS OF DUAL ENERGY X-RAY ABSORPTIOMETRY IN CLINICAL PRACTICE

L. Tsankov, N. Tochev, P. Stefanovski,

Department of Image Diagnostic, University Hospital "Dr. G. Stransky" - Pleven
Lubomir Tsankov, MD; Image diagnostic dept. University Hospital "Dr G. Stranski" - Pleven phone: 064/886270
lyubomirtsankov@yahoo.com

Abstract— Against the backdrop of clinically significant disease osteoporosis, dual energy X-ray absorptiometry (DXA) of the vertebral bodies and femoral neck in the front-rear projection has established itself as primarily an instrumental tool for diagnosing osteoporosis assessment of fracture risk and monitoring the effects of medication. With the development of methodology in clinical practice are increasingly used and some special applications of the methodology DXA - morphometry of the vertebral bodies and femoral neck, study of body composition and bone mineral content of the whole body and in its individual areas and study bone around the artificial joints.

Index terms- DUAL-ENERGY X-RAY ABSORPTIOMETRY, OSTEOPOROSIS, OTHER METHODS.

Dual energy X-ray absorptiometry (DXA) of vertebral bodies and femoral neck in the front-rear projection has established itself as primarily an instrumental means of putting osteoporosis diagnosis, assessment of fracture risk and monitor the effect of the medicated treatment. With the development of the method in clinical practice more often used watt and some special applications of the methodology DXA – morphometry of vertebral bodies and femoral neck, study body composition and bone mineral content of the whole body in its separate areas, examination of the bone around artificial joints and the like. These applications software installed in the ostedenzinometar.

Morphometry vertebral bodies with DXA (X-rayabsorbtion morphometry or Lateral vertebral assessment). Vertebral morphometry is a description of the shape of the vertebral bodies based on the profileX-ray images of the thoracic and lumbar spine.

The objective is to quantify the type and extent of vertebral deformation. In the past it happened after ralization of two profile X-ray images - of thoracic and lumbar spine. Today this can be done using methodology DXA. Quantitative morphometric methodology was denoted by the term MXA (morphometric X-ray absorptiometry), and semiquantitative - the term VFA (vertebral fracture assessment). After displaying the thoracic and lumbar DXA spine with each vertebral body outlines with the help of 6 points: 4 thereof located on its edges, and 2 points - in the media minutes of cortical plates (Fig. 1).

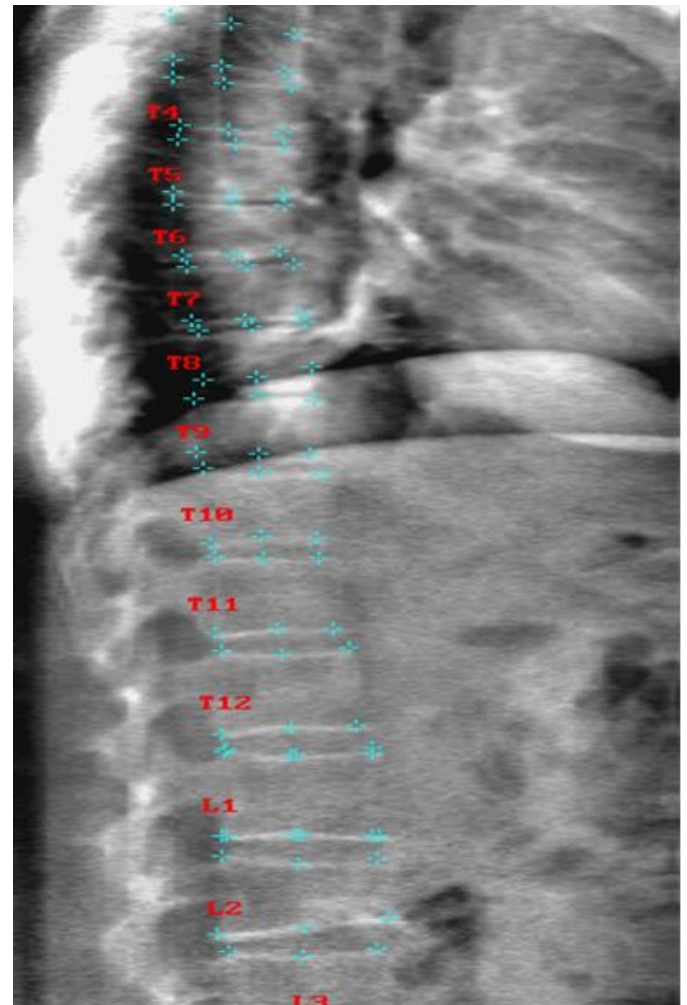


Fig. 1. Location of the points on the outline of the vertebral bodies in vertebral morphometry

These points allow comparing front, front and rear heights vertebral bodies among themselves and with neighboring vertebrae. At the end of the last century is putting the quantitative morphometric techniques (of McCloskey, Eastell, etc.), but in daily clinical practice benefits introduced by

H.Genant semi-quantitative morphometric method. He rely on visual assessment and classification of physician specialists.

Each vertebra from T4 to L4 is classified as:

- normal - level 0
- slightly deformed - first class: a reduction of 20-25% of front, middle or rear height
- moderate deformed - second degree: 25-40% discount of any height)
- severely deformed - fracture III grade > 40% decline in height.

The classification of H. Genant is shown in Fig. 2

The total fracture sum is divided by the number of evaluated vertebrae and spinal fracture index calculated (Spinal deformity index, SDI). The method described includes expert assessment, but also generates quantitative magnitude to serve for accurate assessment and detailed monitoring respondents.

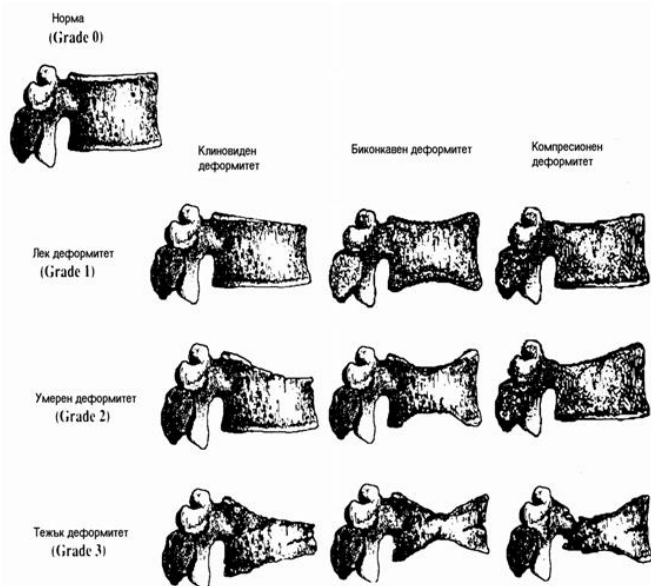


Fig. 2 Semi-quantitative vertebral morphometry of Harry Genant. Today offered by Genant methodology is the "gold standard" for the assessment of vertebral fracture deformities.

In the penultimate opinion International Society Clinical Densitometry (ISCD) renamed this method in Vertebral Fracture Assessment (VFA). Used still and other names - LVA (Lateral Vertebral Assessment) or IVA (Instant Vertebral Assessment)

Developments in the study of the proximal femur Osteodensitometry developments in the proximal femur. Osteodensitometry developments in the proximal femur are reduced to 4 major innovations: evaluation of the length and angle of the femoral neck, simultaneous evaluation of both femoral neck, explore new areas of interest and software upgrades for morphometric evaluation of semier image. The relationship between the geometry of the femoral neck and

fracture risk is already proven- each additional centimeter length of femoral neck fracture increases risk by 10-20%. The determination of the hip axis length is now routine procedure newer models Osteodensitometry /figure/ 3.

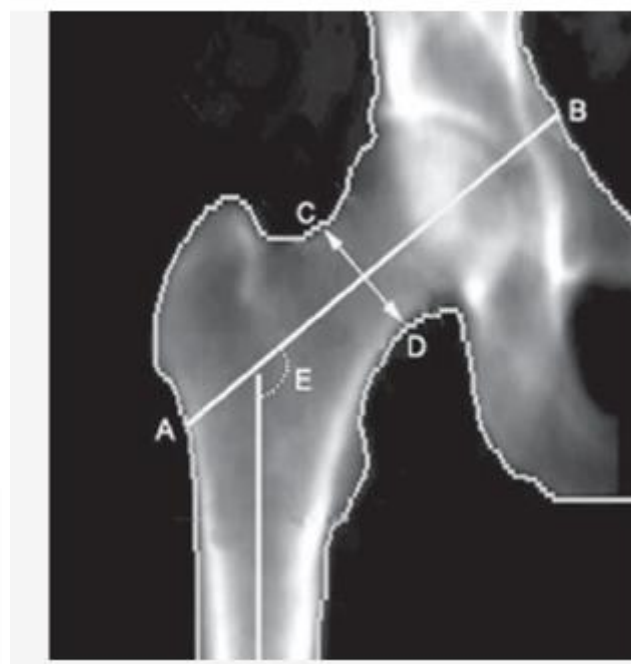


Fig. 3 Calculation of the length and angle of the femoral neck

- Hip axis geometry analysis

Another approach is the simultaneous measurement of both proximal femur (DualFemur), which reduces the error of reproducibility and helps especially in cases of limit value ties of BMD. Such averaged found a place in monitoring bone changes under the influence of age, diseases or medications.

A third approach to increasing the sensitivity of the proximal femur Osteodensitometry is the introduction of specific cortical and trabecular areas of interest. There are various new areas of interest: trabecular, which is listed in the proximal femoral metaphyses circle and cortical, which is a rectangle, placed horizontally in the femoral stem, just below the lesser trochanter. Of all the areas of interest trabecular area is associated with at high relative risk (odds ratio) for fractures of the femoral neck. Cortical area gives you information about carrying the weight of the body bone area. Another suggestion is to use external (upper) half of the rectangle hip neck (femoral neck), since this is the area with increased trabecular content (fig. 4). This is the area where often starts fracture line in the femoral neck.

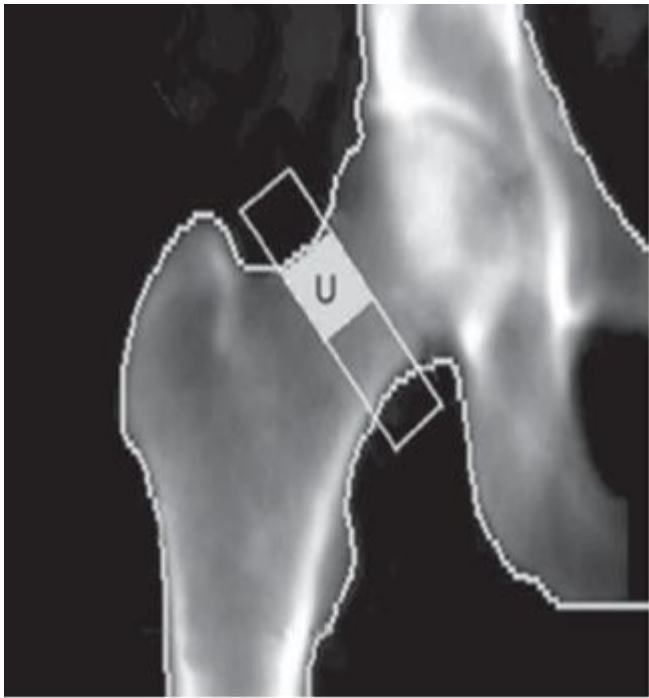


Fig. 4 New areas of interest - external (upper) half of the rectangle at the femoral neck

Assessment of body composition and regional BMD

The study of body composition in living people have long attracted the attention of medics. Studies in fields such as growth disorders, obesity, and cachexia, aging, neuromuscular changes and sports medicine often focus interest on changes in individual body components. The pharmaceutical industry uses the study of body composition to assess the effectiveness of drugs for weight reduction and the development of improved food products for infants and children. Used in the past dual-photon absorptiometry today is entirely displaced by its X-ray modification - DXA. In the current study body composition with DXA using three-compartment model, which includes the following components:

- adipose tissue (fat mass) quantitative triglycerides in the body
- lean body mass - fat, which can include mineral skeleton (usually it is treated separately)
- bone mineral content (BMC)

The resulting image is analyzed semi./fig.5/

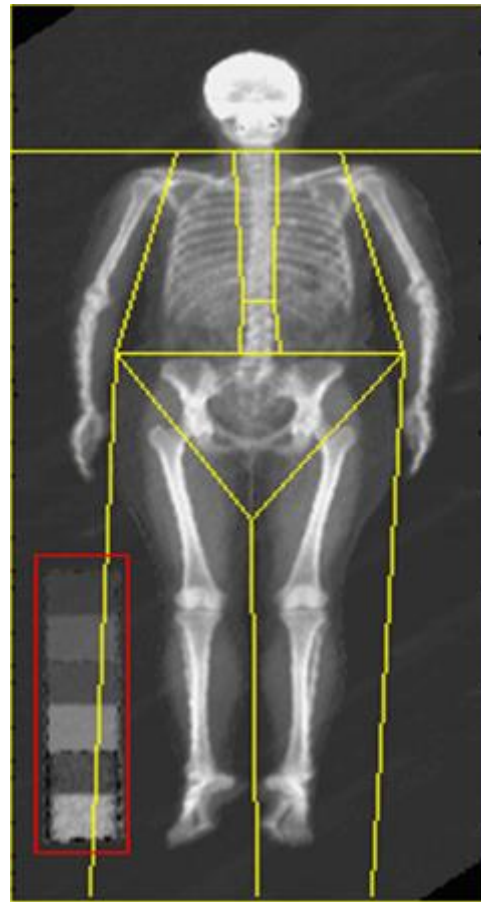


Fig. 5 Areas of interest in the study of body composition with DXA - from proximal to distal: head left and right rib area, thoracic and lumbar spine, pelvis, left and right arms and legs

The study of body composition with DXA is about to take among the "gold standard" in the study of obesity and the effect of anti-obesity drugs. It is the evaluation of the distribution of body fat to become the an integral part of the assessment of total cardiovascular risk. Body distribution is of great interest in studies on athletes. Research on body composition with DXA is used in a number of chronic diseases such as diabetes, end stage renal disease undergoing hemodialysis, chronic obstructive pulmonary disease, syndrome acquired immune deficiency and the like. Scan of whole body is seriously used in neonatal and pediatric practice as the standard software for evaluation BMD of the forearm, femoral neck or vertebral bodies in these patients proved unworkable. Of particular interest is the whole body DXA scan and menopausal and geriatric medicine - track the accumulation of fat and decrease in muscle mass with age.

Whole body DXA scan is yet to find its place in large epidemiological studies on body composition in healthy populations and changes in the course of today's unhealthy lifestyles and nutrition.

DXA study of periprosthetic bone mineral content

DXA method used more widely and in traumatologic practice. It is the application of specific programs such as hip

prosthesis analysis (analysis of hip prostheses. Preserved bone around the implant be investigated the resulting image is divided into a series of zones of interest (areas of Gruen), which allow to eliminate the overlapping of the metal to be compared with the BMD of similar zones of a healthy femur, as well as to trace BMD in time. This research is particularly important in the evaluation of periprosthetic osteoporosis and the risk of loosening of the implant.

In conclusion, the methodology DXA today offers a range of medical applications beyond the standard measurement of BMD.

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