PITFALLS AND PRACTICAL APPLICATIONS: BONE DENSITY TESTING IN CLINICAL PRACTICE

JoAnn Caudill, RT, BD, CD, and Kelly Trippe, MA

Guest Editor: Neil Binkley, MD

In today’s complex medical environment, it is impossible to be expert in everything. And so, we rely on technical experts to provide accurate results and interpretation of laboratory and imaging studies. In the case of DXA scanning, we rely on a technologist to acquire and analyze the scan, followed by a radiologist or subspecialist to review the scan and compile a report that we can use to assess a patient’s bone density, fracture risk, and therapeutic response.

In most cases, referring physicians receive not the actual DXA scan images but only a dictated report from which clinical decisions must be made. Problems can arise when there has been some error in the acquisition, analysis, or reporting of results.

This issue of “Osteoporosis Clinical Updates” discusses what may go awry in DXA acquisition, analysis, and reporting, potential consequences of these errors, and how clinicians can recognize problems and take corrective action.

Editor in Chief
Angelo A. Licata, MD, PhD

Contents

Bone Density Testing: Clinical Challenges ...................................................... 2
Osteoporosis: Clinical Updates ................................................................. 2
What Should a Baseline DXA Report Contain? ............................................ 3
Follow-Up DXA Reports ........................................................................... 3
Using BMD for Fracture Risk Assessment .................................................... 5

Assessing DXA Quality: Case Discussions .................................................. 6
Case 1: 65-Year-Old Postmenopausal Woman .......................................... 6
Case 2: 55-Year-Old Postmenopausal Woman .......................................... 7
Case 3: 55-Year-Old Woman with Significant Decrease in Spine BMD ............ 7
Case 4: 64-Year-Old Man on Glucocorticoids ............................................ 9

Summary .................................................................................................. 10
References .............................................................................................. 10
Sample DXA Report .................................................................................. 11
Bone Density Testing: Clinical Challenges

Dual-energy x-ray absorptiometry, or DXA, was developed as a noninvasive means of calculating bone mineral density (BMD). It is very accurate (~92-95%) at commonly measured sites. That is, the DXA measurement of bone mineral content correlates at better than 90% to actual mineral content in cadaver bone ash. The machine precision (without factoring in human error) is even higher, estimated at 96%-99% at the spine and hip.\(^1\) DXA is recognized as the clinical “gold standard” for measuring BMD and monitoring response to therapy.

DXA is an excellent tool to assist in the determination of fracture risk. Since the 1990s, a T-score based classification has been used in which the patient’s BMD is compared to a database of young normal individuals. The T-score number indicates the deviance of a patient’s measurement from the reference dataset. Negative T-scores are lower, and positive T-score higher, than the reference database mean. T-scores, and the WHO classification, should not be applied to premenopausal women or men under age 50.

Technical excellence is required to use DXA for accurate diagnostic classification and for monitoring BMD change over time. Since BMD changes slowly, often even in response to therapies, it is necessary to appreciate the error inherent in the measurement process.

Because the increments of BMD change are small, discriminating real change from testing variability is necessary. The least significant change (LSC) tells us whether we can reasonably say that the reported
variability. DXA LSC must be determined by each testing facility. This value depends on many factors, including the patient population being scanned, skeletal site measured, patient positioning, and technologist’s skill.

If you do not receive the LSC with your DXA report, request it from the testing facility. Note that LSCs are calculated on the basis of BMD (g/cm²), not T-scores. A sample DXA report with information on precision and LSC analysis is shown at the end of this article.

What Should a Baseline DXA Report Contain?

The International Society for Clinical Densitometry (ISCD) recommends that the following information be included in an initial DXA report:

- Patient demographics (name, medical record number, date of birth, gender, etc.).
- Name of referring provider.
- Indications for the test.
- Manufacturer and model of instrument used.
- Any limitations of the study, e.g., why a specific site or region of interest is invalid or not included.
- Scanned skeletal sites, regions of interest, and side of body measured.
- T-score (comparison to young-adult population) and/or Z-score (comparison to age-matched population) when appropriate (if multiple, use the lowest [worst] T-score of the lumbar spine, femoral neck, total proximal femur, or radius for diagnosis).
- WHO criteria for diagnosis in postmenopausal women and in men age 50 and over.
- Risk factors, including previous non-traumatic fractures.
- Statement of fracture risk. General statement that medical evaluation for secondary causes of low BMD may be appropriate.
- Recommendations for next BMD study.

Clinicians must appreciate that artifacts are often present THAT affect the measured BMD. A very common example is spinal degenerative changes that increase the BMD value (Figure 1).

The DXA report should explain this exclusion and recommend follow up or additional imaging, as this may signal problems such as arthritis, fracture, malignancy, or other conditions.

In addition, the ISCD recommends that the following information NOT be included in a DXA report:

- In the absence of past BMD, no comparative “loss” or “gain” should be indicated. This recommendation reflects the fact that T-scores compare with the average young normal BMD. Based upon a single scan, one cannot determine if a patient has achieved average BMD.
- No designation of disease severity such as “mild,” “moderate,” or “marked” osteopenia or osteoporosis. “Severe” or “established” osteoporosis is an appropriate diagnosis when the T-score is -2.5 or lower and the patient has sustained a prior fragility fracture.
- No separate diagnoses for different regions of interest (e.g., “osteopenia at the hip and osteoporosis at the spine”).
- No expressions, such as “She has the bones of an 80-year-old,” if the patient is not 80 years old.

The World Health Organization’s 1994 diagnostic criteria for T-score measurements are:

- T ≥ -1.0 Normal bone density
- -1.10 to -2.4: osteopenia (“low bone density” or “low bone mass”)
- T ≤ -2.5: osteoporosis


**Figure 1.** A DXA report should indicate any regions of interest that are outliers and should exclude them from calculations of BMD and T-score. This scan here shows an example of a vertebra (L4) with significantly higher density than the others measured. It should be excluded from average BMD calculations.
No BMD results from skeletal sites that are not technically valid (for example, Ward’s triangle).

No reported changes in BMD that exceed precision error and LSC.

**Follow-Up DXA Reports**

The cornerstones of reliable serial DXA testing are consistency, comparability, and relevance. Any procedural change between one DXA measurement and the next can result in unreliable results. This would include things such as a minute change in patient position, a modified analysis technique, and/or updated machine software.

How can a DXA report be used to answer the clinical question: Is my patient’s BMD changing? To answer this, it is necessary to know the LSC of the testing facility. If it is not on the report, you can request it. “Differences” in BMD less than the LSC indicate no change. In other words, a “loss” or “gain” that is not significant cannot be interpreted as an actual change.

It is important to recognize that large changes in BMD very rarely occur over a short period of time. For example, a 25% increase at the spine or a 40% loss at the hip should prompt scrutiny of the test. Such changes are not typical physiological ones and suggest that technical errors may have occurred. In cases like this, it is appropriate to review both current and previous scans. Ideally, the interpreting clinician addresses this type of discrepancy before it reaches the referring clinician. However, not all DXA centers have trained and experienced technologists and/or interpreting clinicians on staff.

When comparing two reports, first document that they are for the same patient. Check to see that everything matches up: gender, date of birth, height, weight, and race. Make sure that your patient’s demographics and history have been accurately reflected in the report.

Review the patient’s medical history to see if there have been changes since the baseline scan that can account for the reported change. For example, are there known surgeries or fractures? One such case is noted in the images below. While the machine printout would indicate increased density in the left hip, it is obviously due, not to improved bone mass, but to surgical hardware, as shown in Figure 2.

Similarly, if the patient has had a spinal compression fracture since the last scan, BMD of the fractured vertebrae may be misleadingly high, given that collapsed vertebrae have greater density than healthy vertebrae. This vertebral body should be excluded from the DXA analysis.

Adjacent lumbar vertebrae usually have roughly the same bone mineral density. If one is significantly different, it should be excluded for the purposes of diagnosis and monitoring. What constitutes a significant difference? There is no single answer. Some experts would exclude vertebrae with greater than 5% variance, while others would exclude those that vary by one or more T-score increment.

A single vertebra should never be used for diagnosis. We want an accurate picture of overall spinal density, rather than density of an individual vertebra.

If one vertebra has a significantly lower density than the others, it should be further evaluated for problems such as cancer. A vertebra with significantly higher density than those adjacent is usually arthritic, but should be evaluated for other causes, such as occult vertebral fracture. Outliers should be excluded as a general principle, but may need further evaluation if there is uncertainty as to the cause of the divergence.

The images in Figure 3 show the follow-up scan (yellow is current bone edge detection) and baseline scan: (yellow=bone edge detection).

Red is the bone edge detection from the baseline scan. Note the L2 deformity. Check the regions of interest.
Figure 3. These images illustrate the importance of visual assessment of scans. It is necessary to compare serial scans to determine changes. The images shown here overlay the new scan (left) and the baseline. Visual comparison reveals a reduction in height and apparent increase in density at L2, indicating the interim occurrence of a vertebral fracture. This fracture will result in an increase in BMD at L2. As a result, L2 should not be included in the DXA report.

Are the same areas of bone measured in both scans? This is necessary because BMD varies within the skeleton — for example, vertebral BMD generally increases progressively from L1 to L4.

Using BMD for Fracture Risk Assessment

BMD is correlated with bone strength and is predictive of future fractures in epidemiologic studies. Thus, bone mass is an important quantifiable indicator of fracture risk.

The reason we perform DXA scanning is to identify patients at high fracture risk in order to prevent the disabling consequences of untreated osteoporosis. However, it is important to recognize that the T-score doesn’t directly translate into fracture risk. It is one of many clinical risk factors.

Although BMD is perhaps the strongest correlate of bone strength, it only accounts for approximately 70 percent of fracture risk. Multiple other factors that contribute to fracture risk have been identified and validated. Of these, the most significant is age. It is well established that fracture risk rises with age independent of bone density.

Comparing two patients with the same hip T-score (-2.5), an 80-year-old is 2½ times more likely to suffer a hip fracture in the next 10 years than is the 50-year-old (Figure 4 below).

Greater care must be taken to avoid fracture in the older patient. Fall prevention, good nutrition, medication compliance, exercise and safe movement — all of these strategies should be in the mix for elderly patients at risk.

To help improve fracture risk prediction, the National Osteoporosis Foundation recommends using the WHO Fracture Risk Assessment Tool (FRAX™). The FRAX™ tool enables practitioners to estimate 10-year fracture risk for treatment-naïve patients based on BMD and verified risk factors.

Pharmacologic intervention is recommended for

Figure 4. Fracture risk is strongly age dependent, increasing with age independent of BMD. The fracture risk for a particular T-score is not the same in a young person as it is in an older person. Multiple factors contribute to this age-associated increase in risk including alterations of bone quality and propensity to fall. This data shows the probability of first fracture of hip, wrist, and vertebrae in women of Malmö, Sweden. (Adapted from Kanis JA et al. Osteoporosis Int. 2001;12:989-95.)
patients with fracture risk above 3% for hip fracture and 20% for major osteoporotic fractures. FRAX™ is designed to be used for untreated postmenopausal women and men over 50 with low bone density but not those with T-scores <-2.5 or prior fragility fracture.

ASSESSING DXA QUALITY: CASE DISCUSSIONS

Case 1: 65-Year-Old Postmenopausal Woman

The first patient we will consider is a 65-year-old Caucasian woman who presents for consultation. Three years ago, she was diagnosed with osteoporosis and prescribed alendronate. After one-year of treatment, follow-up DXA showed a 5% increase in L1-L4 BMD. However, her current report, 2 years later, shows a significant BMD loss at L1-L4 of approximately 9.8% — well over the DXA center’s LSC. Does this mean the medication has stopped working? It is possible; however, rapid BMD decline in a patient who has responded to therapy is not the norm. Further investigation is needed to rule out anomalies in the measurement or reporting process.

The clinician requests printouts from all three scans. Comparing them side-by-side, is it apparent what has gone wrong? Notice that the current scan is mislabeled, resulting in a faulty comparison of vertebral densities. The clinician requests a re-analysis of the follow-up scan by the DXA technologist.

It is not necessary to obtain a repeat DXA. When the scan is re-analyzed, the correct L1-L4 BMD is found to be 0.788 g/cm², thus indicating no significant change from follow-up 1. Stable BMD is associated with reduced fracture risk. No changes are needed.

If these scans were appropriately reviewed initially, the interpreting clinician should have requested the DXA technologist reanalyze the scans properly to achieve the correct analysis.

Case 2: 55-Year-Old Postmenopausal Woman

This patient presents for evaluation based on her recent DXA results. The 55-year-old healthy Caucasian woman had a baseline DXA three years ago at menopause. She recently had a follow-up scan and was very concerned about the results, in which the interpreting clinician reported a significant drop in her hip BMD.

The patient is alarmed by the DXA report, which indicates a 25% decrease in BMD since her last scan. She is very concerned that she should curtail activities for fear of fracture.
Is this an expected change for a postmenopausal female at a three-year follow-up DXA scan visit?
A 25% drop in hip BMD in three years is not a typical physiologic change. In fact, it should raise a red flag about the accuracy of the report and/or scan.

The clinician takes a closer look at the DXA images used to generate the report.

What may be contributing to a misleading DXA T-score?
In the baseline scan, the test was done on a Hologic machine. In the second, a GE Lunar device was used. Comparing scans from different manufacturers cannot be done because different scanning techniques are used. Furthermore, the clinician sees that the hip rotation is not comparable between scans. This would result in divergence between scans even if the same machine were used for both.

As a result, no definitive statement can be made about any change in the bone density. Follow-up scans for monitoring purposes must be done with the same machine. Ideally, patients have follow-up DXA on the machine originally used. In many cases this isn’t possible. In such cases, the new DXA result is used as the baseline for future scans to be performed on the new machine.

Case 3. 55-Year-Old Woman with Significant Decrease in Spine BMD
The next patient we will look at is a 55-year-old postmenopausal woman. She had her first DXA two years ago. At that time, her hip and spine bone density were within the normal range (hip BMD 0.942 g/cm², T-score of 0.0 and L1-L4 BMD 1.342 g/cm² with a T-score of +1.0).

She was not prescribed any medication for bone loss and was counseled to return for DXA in three years.

The patient’s follow-up DXA scan shows a slight decrease in hip BMD (down ~2%, 0.920 g/cm²) with a huge, ~23%, drop at the spine (L1-L4 BMD 1.031 g/cm², T-score -1.4). The patient is very worried. She has stopped her regular exercise routine because she fears breaking a bone.

Is 23% an expected BMD decline in three years?
No. It would be very unlikely that a patient would

---

NOF's Support Group Program

- NOF sponsors osteoporosis support groups throughout the country. Patients can benefit in many ways from joining a support group:
  - Learning more about the disease and treatment choices
  - Receiving the most up-to-date information about osteoporosis
  - Improving coping skills by learning how others handle the disease
  - Exchanging information about community resources
  - Helping identify healthcare providers who treat osteoporosis
  - Improving mental and physical well-being
  - Finding hope and encouragement

Starting a Support Group
If you are interested in starting your own support group, review and complete the NOF Support Group Application, available online at www.nof.org under Connect to Our Community

Support Group Resources
NOF provides all support groups leaders with excellent resources including:
- Support group manual — A comprehensive guide to help you start, promote and conduct successful support group meetings.
- Free educational materials — NOF will provide brochures, information sheets, quarterly newsletters, PowerPoint presentations, posters and more.
- Networking opportunities — NOF will connect you with other support group leaders to help you network and exchange ideas.
- Topics and program ideas — NOF maintains a list of topics and program ideas.
- Referrals — NOF will direct all inquiries to join a support group in your area to you, helping you grow your membership.

For more information on joining a support group or to find a support group in your community, contact the National Osteoporosis Foundation at (202) 223-2226 or toll free at (800) 231-4222.
suffer this magnitude of bone loss in three years. Something strongly suggests an error in DXA acquisition or analysis.

The clinician reviews the data and sees that vertebrae L2 and L3 have significantly lower BMD than adjacent vertebrae.

Is the divergent densities at adjacent vertebrae a red flag?
Because there is such a discrepancy between adjacent vertebrae, the clinician reviews the images from baseline and follow-up scans to see if there is any obvious abnormality to account for the change.

The clinician can see from the image that there has been a noticeable change in the vertebral bodies L2 and L3.

Review of the patient's medical record reveals the cause of this change. The patient has had laminectomy of L2-L3 (shown at arrow below). As a result of the laminectomy, considerably less bone exists in these vertebrae (note the hollow appearance of L2 and L3 vertebral bodies in the 2012 image). The result is a precipitous drop in BMD at this location.

Does this patient have osteoporosis on the basis of her spine BMD?
No. Her hip BMD and spine BMD, excluding the area of laminectomy (L1 and L4, 1.140 g/cm², T-score -0.2), are normal. She is advised to continue her activities and to have a follow-up DXA in two years.

Case 4. 64-Year-Old Man on Glucocorticoids
The next patient is a 64-year-old man who has a current and past history of chronic glucocorticoid use for
rheumatoid arthritis. He had a baseline BMD by DXA three years prior.

At baseline, the patient’s L1-L4 BMD was 1.100 g/cm² (T-score 0), with hip BMD of 0.926 g/cm² (T-score -1.5).

His follow-up report shows an increase in BMD at the spine (up 9.5% to 1.220 g/cm²; T-score +1.1), but a decline at the total hip (0.855 gm/cm², down 7.6%).

**The patient is reassured, but the clinician is suspicious.**

Given that the patient has a history of glucocorticoid use and is older than at the time of his last DXA scan, the clinician expects a decline in both spine and hip.

**The clinician reviews the scan image.**

The patient’s baseline DXA report was done on the same machine and in the same facility as the follow up. The facility has an appropriate LSC of 0.027 g/cm² for the lumbar spine region L1-L4.

Details of the patient’s biographical information checks out. He reports no significant illnesses, surgeries, or changes in medications since the prior DXA. One detail stands out: since the last report, the patient has lost 1” in height.

On viewing the scan image, the clinician sees what may be a compression fracture at L2.

<table>
<thead>
<tr>
<th>Level</th>
<th>T-score</th>
<th>BMD g/cm²</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1</td>
<td>-1.3</td>
<td>0.850</td>
</tr>
<tr>
<td>L2</td>
<td>+2.8</td>
<td>1.481</td>
</tr>
<tr>
<td>L3</td>
<td>-1.1</td>
<td>0.880</td>
</tr>
<tr>
<td>L4</td>
<td>-0.6</td>
<td>0.972</td>
</tr>
<tr>
<td>L1-L4</td>
<td>+1.1</td>
<td>1.201</td>
</tr>
</tbody>
</table>

The patient has much higher density at L2, possibly resulting from a vertebral compression fracture. Vertebral fractures compress the bone into a smaller area, leading to higher density values in terms of grams per square centimeter. This results in misleading density measurements. Rather than an indication of increased or stable BMD, compression fractures such as these indicate osteoporosis and high fracture risk.

**The clinician prescribes treatment for osteoporosis.**

Regardless of T-score, the presence of compression fractures is sufficient for a diagnosis of osteoporosis secondary to glucocorticoid use. Chronic glucocorticoid therapy (equivalent to 5 mg or more of prednisone daily for three months or longer) is an indication for vertebral fracture assessment, or VFA.

**Summary**

DXA is a great tool, but it is not foolproof. Its automated assessment algorithm can’t replace the clinical judgment of a trained professional. It’s up to the technologist and the interpreting clinician to rule out errors and oversights that come with using the technology. Without accurate measurement and interpretation, patients can easily be misdiagnosed, prescribed
medications they don’t need, and/or suffer fractures that could have been avoided.

REFERENCES


Dear Dr. XXX,

2/6/2012

Your patient XXX completed a BMD test on 2/3/20012 using the Lunar Prodigy DXA System (analysis version: 10.00) manufactured by GE Healthcare. The following summarizes the results of our evaluation.

**PATIENT BIOGRAPHICAL:**

Name: XXX  
Patient ID: #######  
Birth Date: 6/2/1970  
Gender: Female  
Fractures: Humerus  
Race: Caucasian  
Height: 66.0 in.  
Exam Date: 2/3/20012  
Weight: 130.0 lbs.  
Treatments: ET-estrogen therapy  
Indications: Amenorrhea, Alcohol (3 or more units per day), Family Hist. (Parent hip fracture), Glucocorticoids (Chronic), History of Fracture (Adult), Secondary Osteoporosis

**ASSESSMENT:**

The BMD measured at Femur Neck is 0.676 g/cm² with a T-score of -2.6. This patient is considered osteoporotic according to World Health Organization (WHO) criteria. Fracture risk is high. Pharmacological treatment, if not already prescribed, should be started. A follow up bone density test is recommended in one year to monitor response to therapy.

<table>
<thead>
<tr>
<th>Site</th>
<th>Region</th>
<th>Measured Date</th>
<th>Measured Age</th>
<th>WHO Classification</th>
<th>Young Adult T-score</th>
<th>BMD (g/cm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right Femur</td>
<td>Neck</td>
<td>2/3/20012</td>
<td>42.3</td>
<td>Osteoporosis</td>
<td>-2.6</td>
<td>0.676</td>
</tr>
</tbody>
</table>

**World Health Organization (WHO) criteria for post-menopausal, Caucasian Women:**

- Normal: T-score at or above -1 SD
- Osteopenia: T-score between -1 and -2.5 SD
- Osteoporosis: T-score at or below -2.5 SD

**RECOMMENDATIONS:**

NOF Guidelines recommend treatment for patients with a T-score of -1.5 and below with risk factors or -2.0 and below without risk factors. Effective therapies are available in the form of bisphosphonates (Fosamax®, Actonel®, Ibandronate (Boniva®, and Zoledronic acid (Reclast®), Calcitonin (Miacalcin®), Raloxifene (Evista®), Teriparatide (Forteo®), estrogen therapies, and Denosumab (Prolia®). All patients should ensure an adequate intake of dietary calcium (1200 mg/d) and vitamin D (400-800 IU daily).

**FOLLOW-UP:**

People with diagnosed cases of osteoporosis or at high risk for fracture should have regular bone mineral density tests. For patients eligible for Medicare, routine testing is allowed once every 2 years. The testing frequency can be increased to one year for patients who have rapidly progressing disease, those who are receiving or discontinuing medical therapy to restore bone mass, or have additional risk factors (hyperparathyroidism, glucocorticoid therapy, etc.)

Based on these results, a follow-up exam is recommended in February 2014.
MONITORING - FEMUR RESULTS:

![Graph showing BMD and T-score]

<table>
<thead>
<tr>
<th>Region</th>
<th>Measured Date</th>
<th>WHO Classification</th>
<th>Young Adult T-score</th>
<th>BMD g/cm²</th>
<th>%Change vs. Previous BMD g/cm²</th>
<th>BMD Change g/cm²</th>
<th>Significant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>10/1/2011</td>
<td>Osteopenia</td>
<td>-1.8</td>
<td>0.776 cm²</td>
<td>3.3%</td>
<td>0.025 g/cm²</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>10/2/2010</td>
<td>Osteopenia</td>
<td>-2.0</td>
<td>0.751 cm²</td>
<td>2.5%</td>
<td>0.018 g/cm²</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>10/24/2009</td>
<td>Osteopenia</td>
<td>-2.2</td>
<td>0.733 cm²</td>
<td>3.7%</td>
<td>0.026 g/cm²</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>10/5/2008</td>
<td>Osteopenia</td>
<td>-2.4</td>
<td>0.707 cm²</td>
<td>2.5%</td>
<td>0.017 g/cm²</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>10/11/2007</td>
<td>Osteoporosis</td>
<td>-2.5</td>
<td>0.690 cm²</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Note: Based upon a precision assessment study* at the 95% confidence level, completed at our facility, the current “Least Significant Change” is 0.027 gm/cm² for the lumbar spine region L1-L4 and 0.030 femur total. Serial differences less than 0.027 gm/cm² at L1-L4 are not statistically significant at the 95% confidence level.

Based upon a precision assessment study completed at our facility, the current “Least Significant Change” is 0.030 gm/cm² for the right femur neck region. Serial differences less than 0.030 gm/cm² at femur neck are not statistically significant at the 95% confidence level.

Based upon a precision assessment study at the 95% confidence level, completed at our facility, the current “Least Significant Change” is 0.028 m/cm² for the right femur total region. Serial differences less than 0.028 gm/cm² at L1-L4 are not statistically significant at the 95% confidence level.

Precision study for other anatomic levels has not been performed.

*Precision assessment describes the ability of a quantitative measurement techniques to reproduce the same numerical result when repeatedly performed in an identical fashion.


FRACTURE RISK RESULTS:

Fracture Type 10-Year Probability of Fracture
Any 54%
Hip 12%

ASSESSMENT:
The patient’s 10-year probability for any fracture is 54 percent.***Either this Frax data should be removed and/or disclaimer added that Frax is not to be used in those who have WHO DXA range c/w OP diagnosis, ie. T-score <2.5

The patient’s 10-year probability for a hip fracture is 12 percent.

Note: Fracture risk estimates are derived from published information from Kanis (Lancet. 2002 Jun 1;359(9321):1929-36) and are based on age and bone density only. Overall fracture risk will depend on many additional factors, which should be considered before making diagnostic or therapeutic recommendations.
Osteoporosis International

Osteoporosis International is the leading scientific journal for clinical research in osteoporosis and related bone diseases. Published monthly, the journal is an international, multi-disciplinary joint initiative of NOF and the International Osteoporosis Foundation.

Free Subscription for NOF Professional Members

NOF STORE: Order Education Materials for Your Patients

Member Discount on All Purchases

How Strong Are Your Bones?

This brochure helps people understand osteoporosis, their risk factors for the disease and the importance of bone healthy behaviors. It explains bone density testing and includes information on when to have a bone density test, what the results mean and when to consider treatment.

A Guide to Osteoporosis Medicines

This brochure will help you better understand your osteoporosis treatment options. It provides information on the osteoporosis medicines approved by the U.S. Food and Drug Administration (FDA), discusses factors to consider when making a treatment decision and the issues you may face in staying with a treatment plan.

Boning up on Osteoporosis: A Guide to Prevention and Treatment

This 100+ page patient care handbook offers up-to-date information on the prevention, diagnosis and treatment of osteoporosis.

Free printable downloads and discounts on print patient education publications for NOF Professional Members