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THE EFFECT OF SMOKING ON OSTEOPOROSIS

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Abstract
Osteoporosis is a disease that effects human skeleton that causes a reduction in bones strength, this paper studied the affection of smoking as a risk factor or increasing the possibility of developing on osteoporosis symptoms where the data were collected for 179 persons (78 males and 101 female) and analyzed using the odds ration test(OR), which is a powerful tool in the clinical research field. The risk of developing Osteoporosis was determined using assessments forms for bone –density aspect. The analysis showed a strong effect of smoking on developing Osteoporosis (Odd ratio: OR=2.07).

Keyword: Osteoporosis, bones, smoking

1-Introduction

Bone tissue (osseous tissue) is a hard tissue composed of cells and an additional cellular design containing organic 35% and 65% internal molecules, the organic matrix is mostly kind I collagen (90%) in small quantities without collagen proteins such as Glycoproteins, Osteocalcin (OC), and Proteoglycans. Phosphate and Inorganic Calcium and form Hydroxyapatite crystals, that organic mineralization matter [1,2].
One of the diseases that affect the bones is osteoporosis, Osteoporosis is a chronic disease of the skeleton that causes decreased bone mass and deterioration of the fine structure of the bones, resulting in an increased risk of fractures [3].

Unlimited and comparable increases in the size of older adults and the unhealthy habits of children and adolescents lead to very significant increases in the incidence of osteoporosis and osteoporosis.

There are so many reasons to emergence and/or osteoporosis. It is called basic osteoporosis When the reasons are natural (menopause and older adults). It's called secondary osteoporosis when there is another main reason (Some drugs, other illnesses, localization, etc.). When the reasons are unknown, it is called Osteoporosis of unknown etiology [4], it currently offers several effective treatments for osteoporosis. Screening, diagnosis, and timely management can reduce the severe consequences of the disease [3], to diagnose osteoporosis, evaluate fracture risk and determining the need for treatment, your doctor may order a bone density test.

There are different types of methods for measuring bone density such as:

1-1 Bone Density Test

(BMD) bone mineral density test is a non-invasive measurement of evaluation the health of the skeletal system. The Gold Standards diagnostic and observe technique is (DXA) Dual-energy X-ray Absorptiometry in the spine, hip or forearm. Although quantitative ultrasound imaging and peripheral DEXA can also predict fracture [5,6,]. Dual-energy X-ray Absorptiometry, also known as densitometric or dual-energy X-ray absorptiometry (DEXA), can discriminate between various body structures. Axial bone densitometry of the lumbar spine and hip is the method most widely used in clinical practice.

For measuring bone mineral density (BMD) useful (DEXA) technique, from this data it is possible to estimate the risk of fracture, processing decisions can make and response to treatment can be evaluated [6,7,8].

DXA machine turns bone density data into Z &T grades. (BDT) does not produce x-ray images, but they measure how easy it is x-rays pass through the bones. The higher the porosity and brittleness of the bone, the more X-rays that pass through it. The quantity of x-rays that pass through the bone is expressed in a scale called a t-degree. The t-degree measures the amount of bone a patient has compared to a young, normal population and is used to estimate fracture hazard and the need for drug treatment [9].

The z-degree measured the bone quantity that the patient compared to those of his or her age group. A t-degree > -1 is consider normal, and a t-score between -1 and -2.5 is considered a few. According to current definitions, people are considered to have osteoporosis if they have a t-score of -2.5 or less. This number can help determine if

further medical examinations are needed. Next steps can be done to identify fractures of bone caused by osteoporosis [8,9] Figure (1) shows a DEXA Scan machine.

Figure (1): DEXA Scan machine [10].

1-2 Bone x-ray

X-rays of the bones produce pictures of the bones inside the body, including the hand, carpus, spindle, elbow, support, foot, leg, knee, thigh, rump, or backbone. it helps diagnose bone fractures that are sometimes caused by osteoporosis [11].

1-3 Computed tomography of the backbones:

A computed tomography scan of the backbones is perfect for evaluation of alignment and fractures. it can be utilized to measure bone density and determine whether spinal fractures are possible [12,13].

1-4 Magnetic resonance imaging of the backbones:

MRI of the backbones is complete to evaluate vertebral fractures for guide of implied disease, such as cancer, to estimate whether the fracture is old or new. New fractures usually show a better response to treatment with vertebroplasty and tuberosity [11,14].

1-5 Tests of blood

Tests of blood are other procedure utilized to diagnose specific disease of bone. One of these diseases is osteoporosis, where the tests of blood utilized to locate hazard parameters and to exclude other diseases. Such as levels of Ca in the blood can be measured to detection to see if someone is getting enough calcium, but that doesn't provide all the information about how much calcium is in their bones.

Other significant parameter of blood is “alkaline phosphatase” the protein that grows if someone suffers from certain bone diseases. Another parameter of may be blood utilized to detect signs of infections, tumors or metabolic diseases that can affect the condition of bones [15].

2- Factors that increase the incidence of osteoporosis

There are many of factors that raise the hazard of osteoporosis, such as:
Age, race, gender, structure of bone and weight of body, history of family, nutrition, lifestyle, drugs, and Smoking [16].

3- Osteoporosis and Osteopenia

Osteopenia & Osteoporosis both are due to low bone density.
Osteoporosis is a condition that affects the density of bone. Bone density decreases, which makes bones spongy and fragile, and they break easily.
Osteopenia is when your bone density is lower than normal but not so low that your bones will break easily, it is the main feature of osteoporosis. Osteopenia is a precursor to osteoporosis. Take steps to improve bone mineral density, including related to diet measures, increase weight bearing exercises, it can prevent osteopenia steps to osteoporosis [17,18].

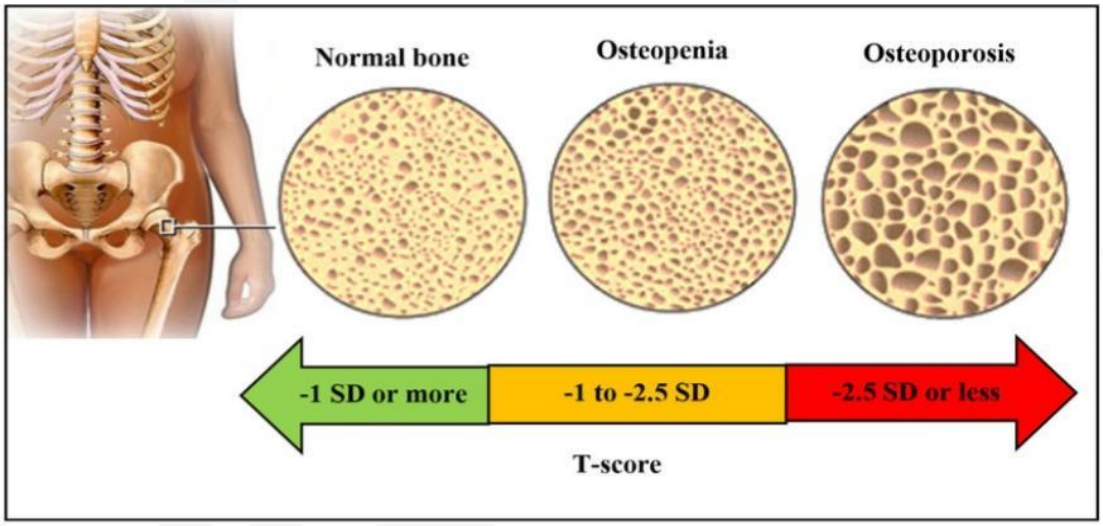

Figure (2): The difference between osteoporosis, osteopenia, and normal bone , and T-Score readings

4-The method of work & Results

In this study, we will examine the effect of smoking on osteoporosis and whether smoking increases the appearance of osteoporosis or not.

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4-1 Case Control:

A sample was taken of 179 male & female (from Karkh/Baghdad), including those suffering from osteoporosis and those who were healthy, smokers and non-smokers. Data was as shown in Table (1):

Table (1): Data distribution for osteoporosis and the effect of smoking on osteoporosis (where M = Male, and F = Female)

Age in years	No smoker No osteoporosis (frequency)	No smoker with osteoporosis (frequency)	Smoker Osteoporosis, (frequency)	Smoker without osteoporosis (Frequency)
19 – 15	1M &1F	1F		
20 – 24	3M &6F	1F		1M &1F
25 – 29	4M &5F			1F
30 – 34	7M &10F	1M &1F		3M &1F
35 – 39	4M & 7F	1M &2F		5M &2F
40 – 44	8M & 9F	2F	1M & 1F	4M &1F
45 – 49	5M & 9F	2F	2M	4M
50 – 54	5M & 7F	1M &3F	1F	2M
55 – 59	2M & 4F	3F		3M
60 – 64	1M & 3F	1F .	1M & 1F	1M
65 – 69	1M &2F	1F	1F	1M
70 – 74	4F	1F	2F	1M
75 – 79	1F		1M	1M
80 – 84	2M & 1F	1F	1M & 1F	
	Tot=43M& 69F	Tot= 3M &19F	Tot= 6M &7F	Tot= 26M &6F

Table (2) Final result of Table (1)

Table (2): The total of samples per case

No smoker No osteoporosis 112	No smoker with osteoporosis 22
Smoker without osteoporosis 32	Osteoporosis, Smoker 13

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4-2 Analysis of case –control studies:

The results of a case-control study can be presented in a table (3) as follow:

Table (3): Analysis of case- control studies

state	Cases Osteoporosis	Control	Total
Smokers	13	32	45
Non-smokers	22	112	134
Total	35	144	179

4-3 Odds Ratio

Odds ratio is a measure of the strength of the association with exposure and outcome. It is a measure of the odds of disease in the smokers compared to the odds of disease in the non-smokers (controls) which we can calculate by the following law [19]:

$$\mathbf{OR=\frac{13*112}{32*22}}$$

OR= 2.07

4-4 Reading Outcomes and Probabilities of Association:

1. If OR is greater than1, it means that there is greater odds of being associated with exposure and outcome.
2. If OR is equal 1, it means there is no correlation between exposure and outcome.
3. If OR is less than 1, this means that there are fewer possibilities of association between exposure and outcome [17].

4-5 Some of diagnostic image of Dexa scan:

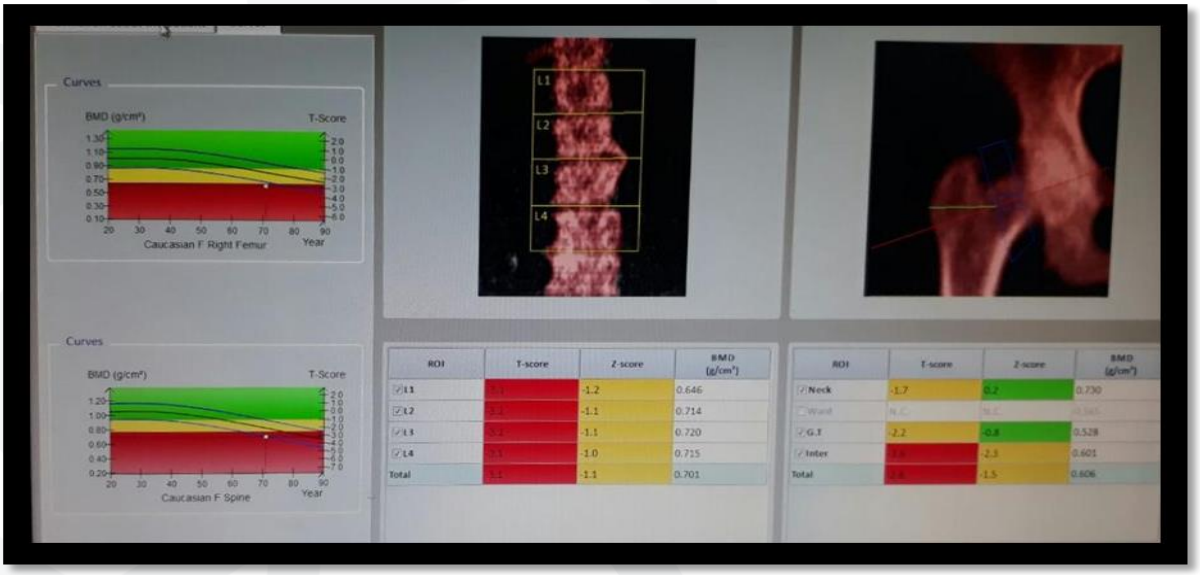

Figure (3): Case of Osteoporosis of the lumbar vertebrae L1, L2, L3, L4 for woman 71 years

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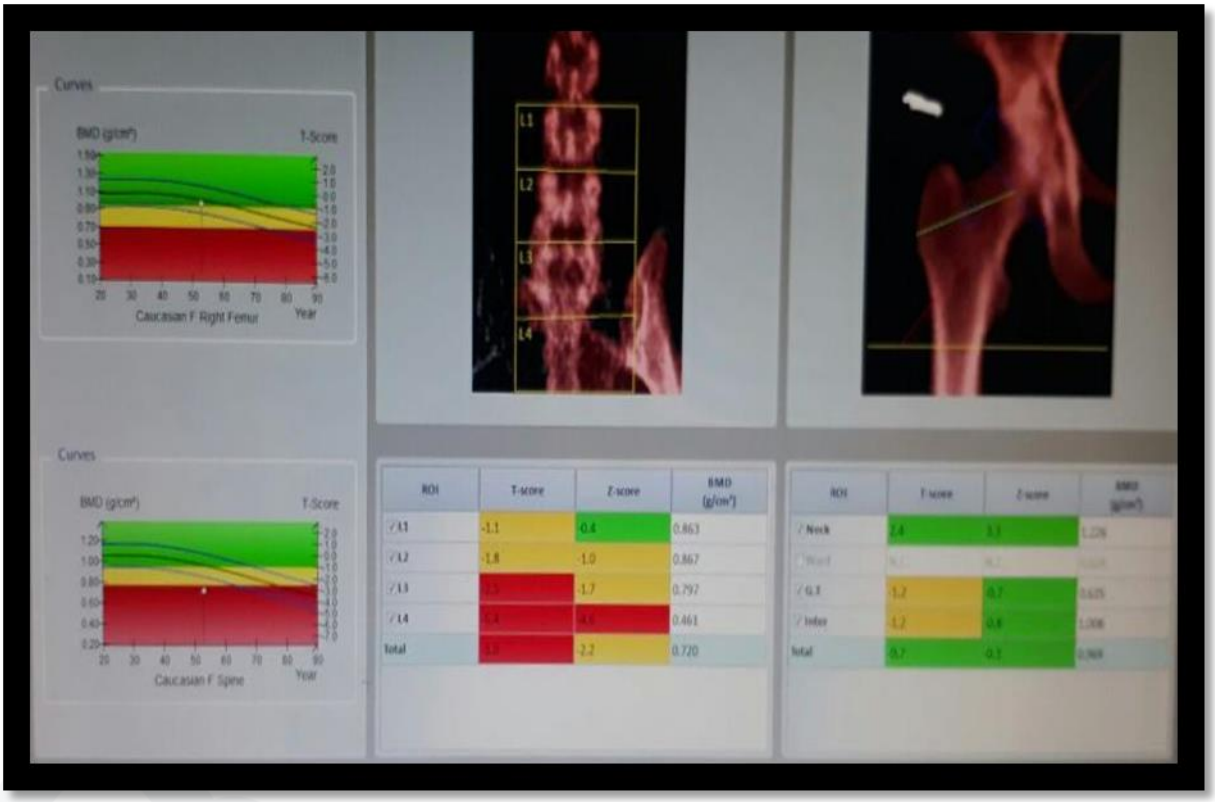

Figure (4): Case of Osteoporosis in L3 ,L4 and osteopenia in L1 ,L2 for woman 52 years

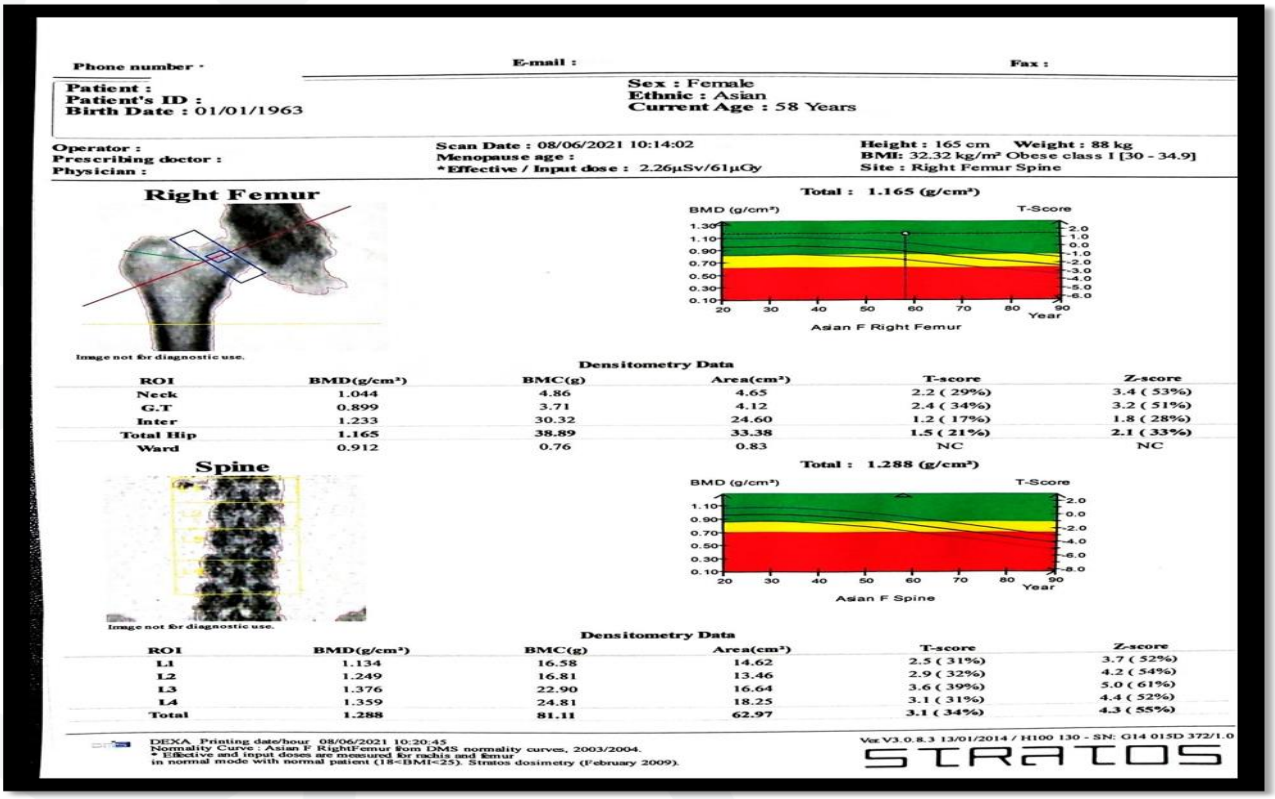

Figure (5): Normal bones test for woman 58 years

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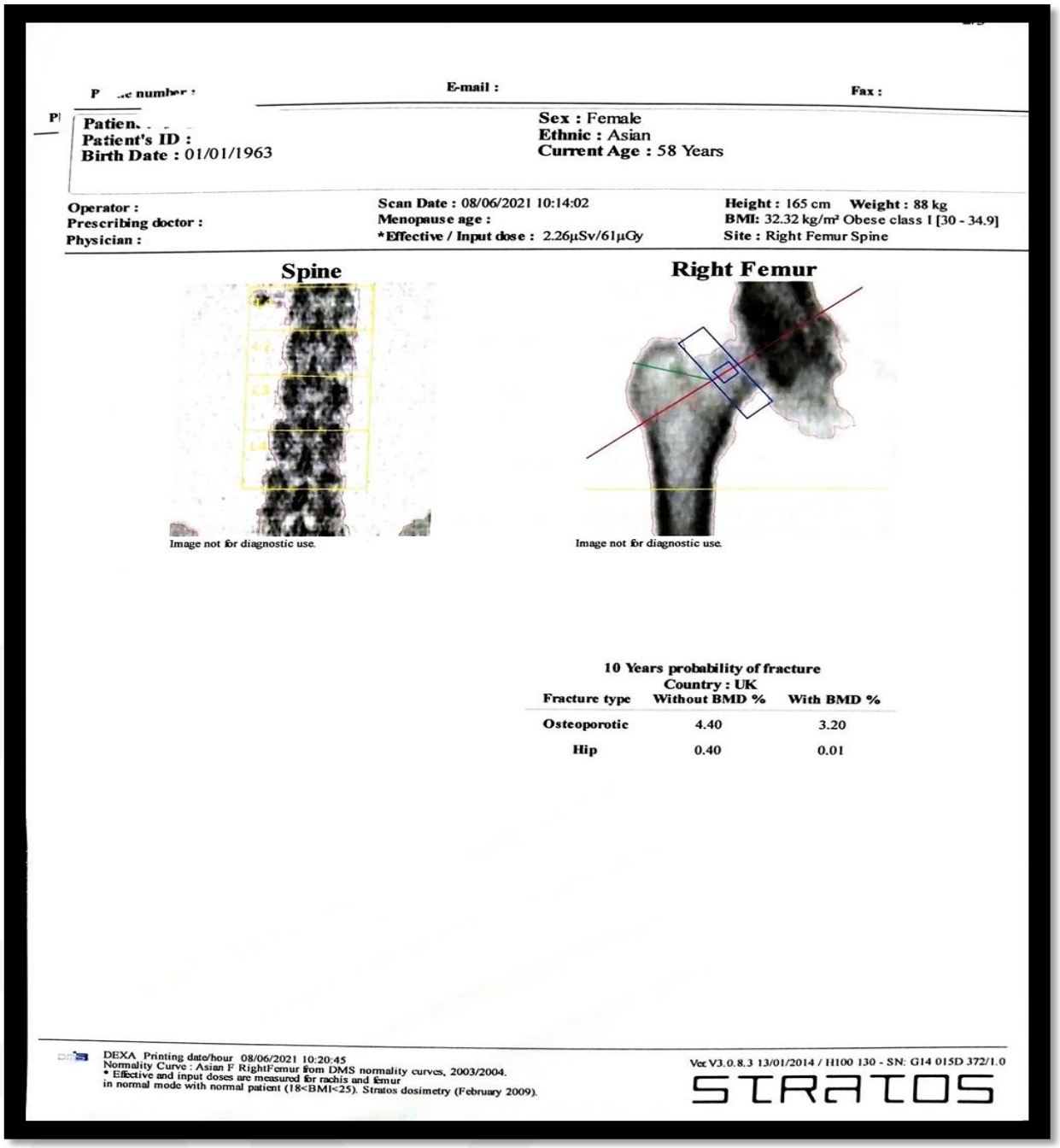

Figure (6): This is 10 years probability of fractures for woman in figure (5)

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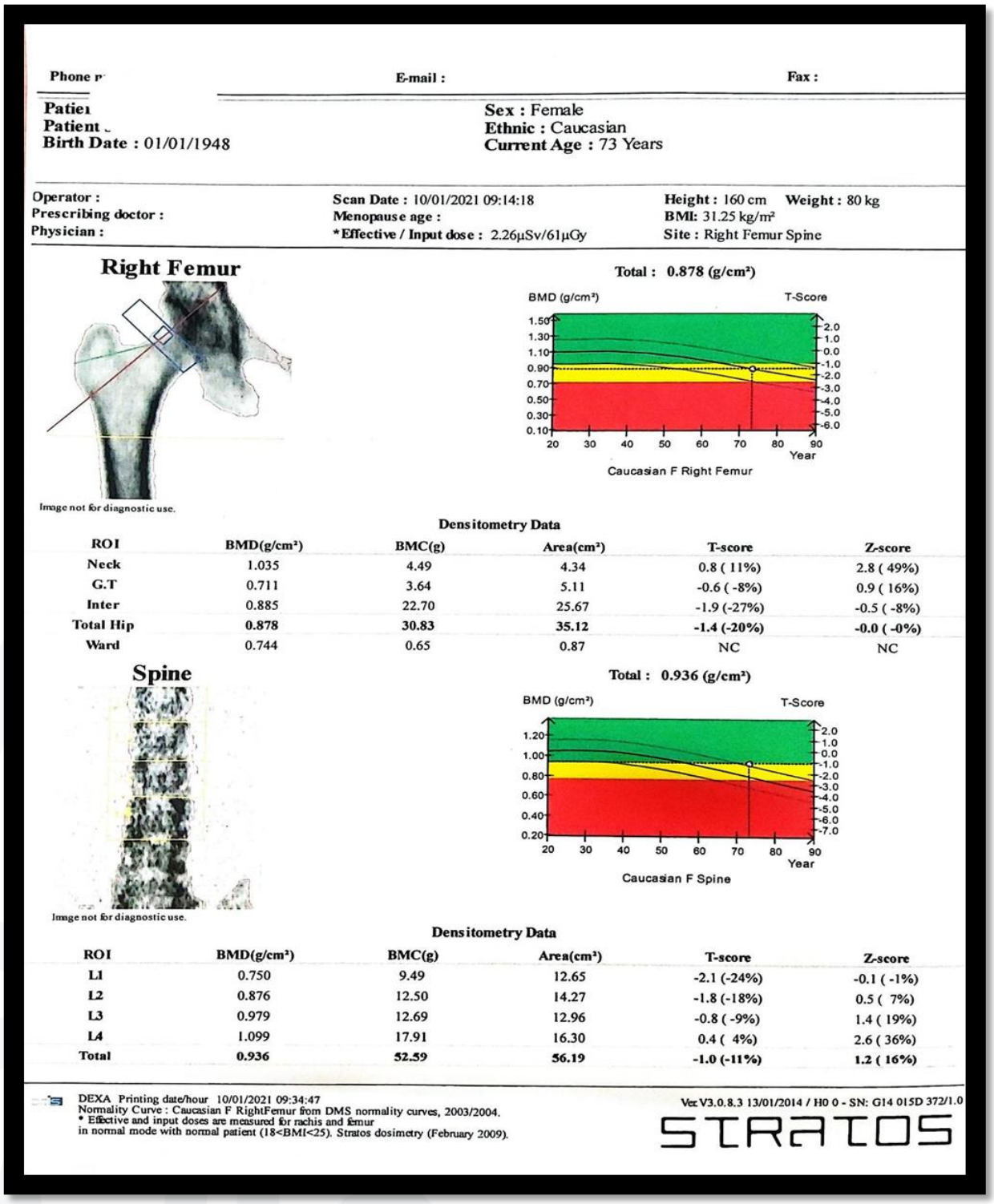

Phone r · E-mail : · Fax :

Patie1
Patient _
Birth Date : 01/01/1948

Sex : Female
Ethnic : Caucasian
Current Age : 73 Years

Operator :
Prescribing doctor :
Physician :

Scan Date : 10/01/2021 09:14:18
Menopause age :
*Effective / Input dose : 2.26µSv/61µGy

Height : 160 cm Weight : 80 kg
BMI: 31.25 kg/m²
Site : Right Femur Spine

Right Femur

Image not for diagnostic use.

Total : 0.878 (g/cm²)

BMD (g/cm²) T-Score

Caucasian F Right Femur

Densitometry Data

ROI	BMD(g/cm²)	BMC(g)	Area(cm²)	T-score	Z-score
Neck	1.035	4.49	4.34	0.8 (11%)	2.8 (49%)
G.T	0.711	3.64	5.11	-0.6 (-8%)	0.9 (16%)
Inter	0.885	22.70	25.67	-1.9 (-27%)	-0.5 (-8%)
Total Hip	**0.878**	**30.83**	**35.12**	**-1.4 (-20%)**	**-0.0 (-0%)**
Ward	0.744	0.65	0.87	NC	NC

Spine

Image not for diagnostic use.

Total : 0.936 (g/cm²)

BMD (g/cm²) T-Score

Caucasian F Spine

Densitometry Data

ROI	BMD(g/cm²)	BMC(g)	Area(cm²)	T-score	Z-score
L1	0.750	9.49	12.65	-2.1 (-24%)	-0.1 (-1%)
L2	0.876	12.50	14.27	-1.8 (-18%)	0.5 (7%)
L3	0.979	12.69	12.96	-0.8 (-9%)	1.4 (19%)
L4	1.099	17.91	16.30	0.4 (4%)	2.6 (36%)
Total	**0.936**	**52.59**	**56.19**	**-1.0 (-11%)**	**1.2 (16%)**

DEXA Printing date/hour 10/01/2021 09:34:47
Normality Curve : Caucasian F RightFemur from DMS normality curves, 2003/2004.
* Effective and input doses are measured for rachis and femur in normal mode with normal patient (18<BMI<25). Stratos dosimetry (February 2009).

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STRATOS

Figure (7): Case of Osteopenia in right femur and spine for woman 73 year

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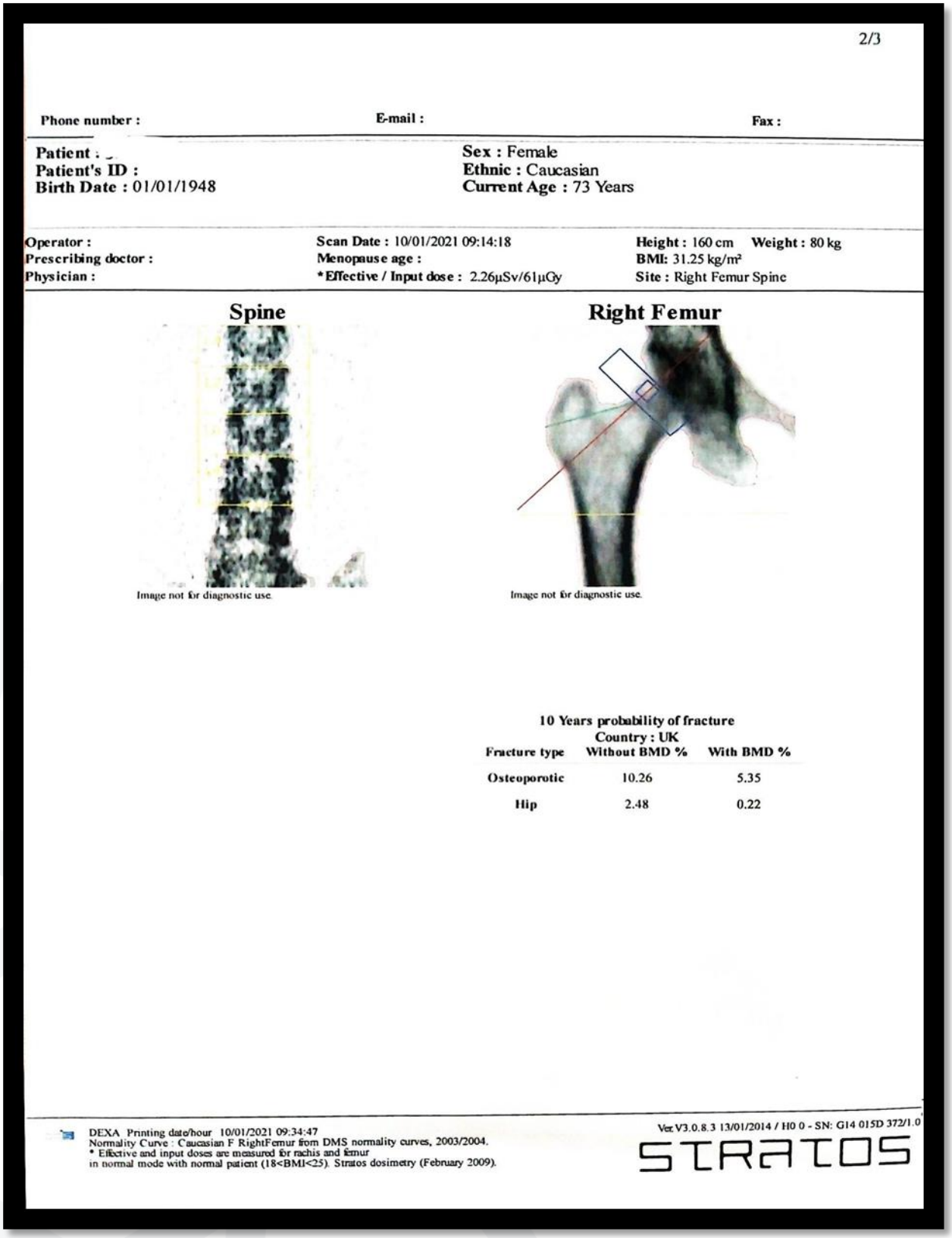

2/3

Phone number : E-mail : Fax :

Patient : _
Patient's ID :
Birth Date : 01/01/1948

Sex : Female
Ethnic : Caucasian
Current Age : 73 Years

Operator :
Prescribing doctor :
Physician :

Scan Date : 10/01/2021 09:14:18
Menopause age :
*Effective / Input dose : 2.26µSv/61µGy

Height : 160 cm Weight : 80 kg
BMI: 31.25 kg/m²
Site : Right Femur Spine

Spine

Image not for diagnostic use.

Right Femur

Image not for diagnostic use.

10 Years probability of fracture
Country : UK

Fracture type	Without BMD %	With BMD %
Osteoporotic	10.26	5.35
Hip	2.48	0.22

DEXA Printing date/hour 10/01/2021 09:34:47
Normality Curve : Caucasian F RightFemur from DMS normality curves, 2003/2004.
* Effective and input doses are measured for rachis and femur
in normal mode with normal patient (18<BMI<25). Stratos dosimetry (February 2009).

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Figure (8): This is 10 years probability of fractures for woman in figure (7)

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Phone number : E-mail : Fax :

Patie1
Patient's ID :
Birth Date : 01/01/1984

Sex : Female
Ethnic : Caucasian
Current Age : 37 Years

Operator :
Prescribing doctor :
Physician :

Scan Date : 06/02/2021 09:31:58
Menopause age :
*Effective / Input dose : 2.26µSv/61µGy

Height : 150 cm Weight : 72 kg
BMI: 32.00 kg/m² Obese class I [30 - 34.9]
Site : Right Femur Spine

Right Femur

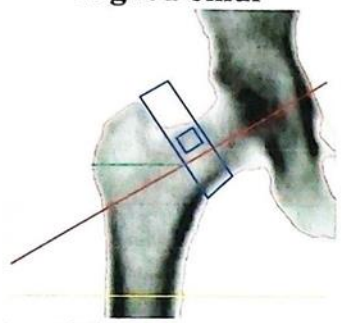
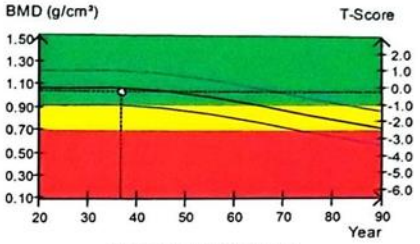


Image not for diagnostic use.

Total : 1.036 (g/cm²)



Caucasian F Right Femur

Densitometry Data

ROI	BMD(g/cm²)	BMC(g)	Area(cm²)	T-score	Z-score
Neck	0.991	4.61	4.65	0.5 (6%)	0.7 (9%)
G.T	0.715	4.95	6.92	-0.5 (-8%)	-0.5 (-7%)
Inter	1.145	25.54	22.30	-0.4 (-5%)	-0.4 (-5%)
Total Hip	**1.036**	**35.10**	**33.88**	**-0.2 (-3%)**	**-0.3 (-4%)**
Ward	0.935	0.78	0.83	NC	NC

Spine

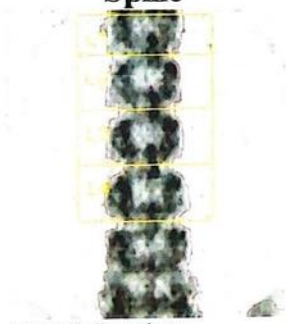
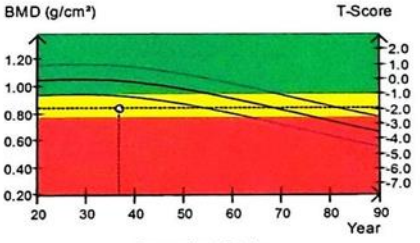


Image not for diagnostic use.

Total : 0.841 (g/cm²)



Caucasian F Spine

Densitometry Data

ROI	BMD(g/cm²)	BMC(g)	Area(cm²)	T-score	Z-score
L1	0.767	7.50	9.77	-2.0 (-22%)	-1.9 (-22%)
L2	0.802	9.51	11.86	-2.4 (-25%)	-2.4 (-25%)
L3	0.901	10.98	12.19	-1.5 (-16%)	-1.5 (-16%)
L4	0.876	11.64	13.30	-1.6 (-17%)	-1.6 (-17%)
Total	**0.841**	**39.63**	**47.12**	**-1.9 (-20%)**	**-1.8 (-19%)**

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Normality Curve : Caucasian F RightFemur from DMS normality curves, 2003/2004.
* Effective and input doses are measured for rachis and femur in normal mode with normal patient (18<BMI<25). Stratos dosimetry (February 2009).

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Figure (9): Case of Osteopenia for woman 37 years

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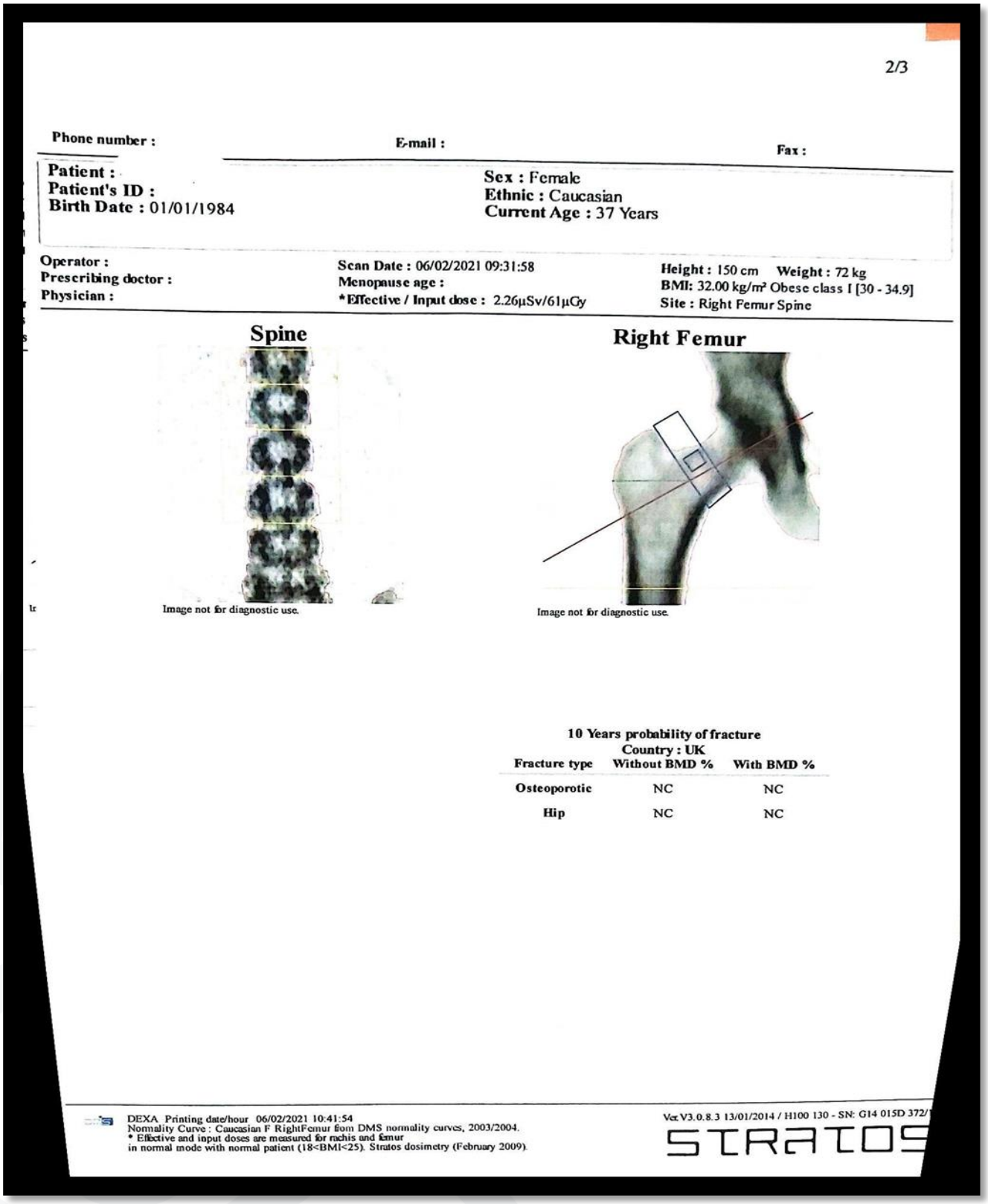

2/3

Phone number : E-mail : Fax :

Patient :
Patient's ID :
Birth Date : 01/01/1984

Sex : Female
Ethnic : Caucasian
Current Age : 37 Years

Operator :
Prescribing doctor :
Physician :

Scan Date : 06/02/2021 09:31:58
Menopause age :
*Effective / Input dose : 2.26µSv/61µGy

Height : 150 cm Weight : 72 kg
BMI: 32.00 kg/m² Obese class I [30 - 34.9]
Site : Right Femur Spine

Spine

Image not for diagnostic use.

Right Femur

Image not for diagnostic use.

10 Years probability of fracture
Country : UK

Fracture type	Without BMD %	With BMD %
Osteoporotic	NC	NC
Hip	NC	NC

DEXA Printing date/hour 06/02/2021 10:41:54
Normality Curve : Caucasian F RightFemur from DMS normality curves, 2003/2004.
* Effective and input doses are measured for rachis and femur
in normal mode with normal patient (18<BMI<25). Stratos dosimetry (February 2009).

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STRATOS

Figure (10): This is 10 years probability of fractures for woman in figure (9)

5-Conclusions:

Smoking helps with osteoporosis in all age groups, males and females, and reduces the efficiency of the hormone calcitonin, which is responsible for increasing the strength and hardness of the bones,
as well as the estrogen hormone, which plays an important role in building bones and protecting them from weakness in women.
as smoking reduces the effectiveness of vitamin D, which plays an important role in building bones, and thus reduces the absorption of calcium required to build bones, smoking also negatively affects the efficiency of blood vessels and nerves, especially the feet and legs, which increases the weakness of the bones and their exposure to fractures,
Since bones take nutrients, oxygen, and minerals from the blood like any other organ in the body, as smoking raises nicotine levels in the blood, this in turn causes blood vessels to contract, and this contraction reduces the diameter of the blood vessels, and as a result, the amount of nutrients that reach the bones is reduced.
Thus, the bone mass decreases until the smoker develops osteoporosis.
Promote a healthy lifestyle, free of (smoking, alcohol and soft drinks), exercise and healthy diet rich in vegetables, fruits, and vitamin D3 and calcium rich to build healthy bones.

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