CORRELATION OF MANUS RADIOGRAPH IMAGE TEXTURE VALUE WITH BONE MINERAL DENSITY LUMBAR SPINE VALUE

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ABSTRACT

Osteoporosis or bone loss is a chronic disease characterized by low bone mass accompanied by changes in micro-architecture of the bone and a decrease in the quality of bone tissue that can cause bone fragility, so that bones are easily cracked or even fractured. Osteoporosis is diagnosed by measuring bone mineral density using DXA (dual-energy X-rayabsorptiometry). Treatment with device this expensive and not widely available. So it is necessary to find an alternative method of detecting a cheap one. This study aims as an initial study to find an alternative way of early detection of osteoporosis by looking for the texture characteristics of the human bone. Sample in This study took 19 people with inclusion criteria including postmenopausal women who declared healthy, not broken bone and has no skeletal abnormalities since birth. Sample measured density mineral bone(BMD) or the degree of osteoporosis with DXA. Then an X-ray is done to get bone image. The stages of the research are: 1) preprocessing X-ray image of the human bone; 2) determine the value of the texture of the human bone image with gray level method co-occurrence matrix 3) test connection between the value of the human bone texture image with BMD lumbar spine. The results of the correlation test show that there is correlation between the value of human bone texture and BMD of the lumbar spine to characterize variance and significantly statistics ($P<0.05$).

Keywords: Radiographic Image; Manus; Texture features; BMD

Introduction

Osteoporosis is a disease characterized by a reduction in bone mass and changes in bone architecture that result in increased bone fragility and an increased risk of fracture.[1,2] This disease will continue to increase in the future.[3] And this disease often occurs in postmenopausal women and elderly men.[4] This disease is also at risk for fractures of the hip, spine, and wrist so that it can reduce the patient's quality of life and cause an increase in the financial burden on the care system.[5] And also causes the risk of death from fractures.[6]

Osteoporosis is defined as a bone mineral density (BMD) that lies 2.5 standard deviation (SD) or more below the average value for young healthy women (a T-score of < 2.5 SD).[7] Examination of bone mineral density (BMD) in high-risk groups is an important effort to reduce the prevalence of osteoporosis. Dual Energy X-Ray Arbsorptiometry (DEXA) is a BMD examination method that is used as the gold standard by the world health organization (WHO).[8]

Examination using DEXA is still quite expensive and not widely available, so it is necessary to look for other alternatives in the examination of osteoporosis. Different bone densities will show different bone textures, so it is necessary to study the characteristics of bone texture.

Radiographically, texture characteristics are one of the important information. Texture analysis is one way to recognize an image, which can be used to distinguish density, uniformity, regularity, roughness, and others. The use of texture analysis in

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medical images has been widely carried out, including for

Know the architecture of the human bones. There are various methods for extracting texture information from an image, one of which is the gray level co-occurrence matrix (GLCM) method.[9,10] So it is important to know the relationship between texture characteristics and BMD values in the lumbar spine.

Methods

The first step is to find data on osteoporosis and normal status from the study sample. Several samples of postmenopausal women aged 55 years and over were brought to the laboratory to have their bone density measured. To get the data using a densitometry (DXA) tool. Then from the sample, an x-ray of the human bone was taken to obtain an image of the human bone.

The second step is to determine the texture value of the manus using the gray level co-occurrence matrix method. The third step is to test the correlation between the value of the human image texture and the BMD value of the lumbar spine.

Results and Discussion

From 19 people measured by Densitometry (DXA) which is a tool for detecting osteoporosis standard WHO obtained 10 osteoporosis data and 9 normal data. an example of a lumbar spine BMD examination (Fig. 2).

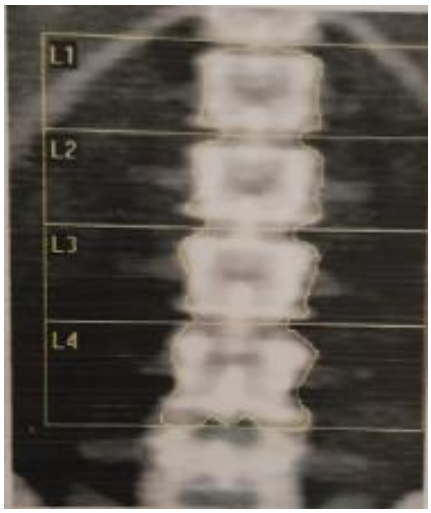

Fig 2. Lumbar spine BMD examination

In the lumbar spine BMD examination, the BMD values were obtained in the L1, L2, L3 and L4 sections, the BMD examination results were as shown in Table 1.

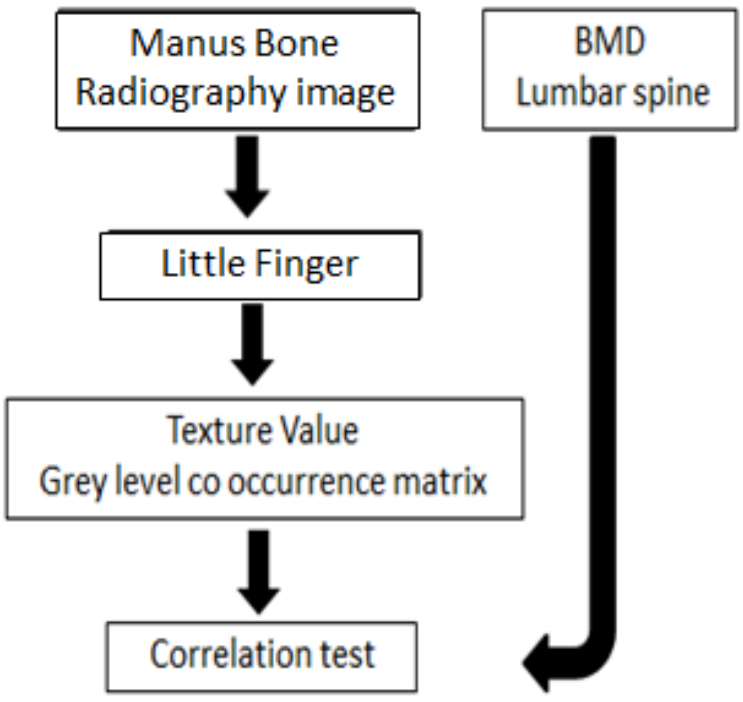

Fig 1. Research Flow

Table 1. Lumbar spine BMD values (gr/cm^2)

No.	BMD L1	BMD L2	BMD L3	BMD L4
1	0.8060	0.9290	1.0250	1.0300
2	0.5690	0.5750	0.5870	0.5850
3	0.6100	0.7040	0.6910	0.7990
4	0.3730	0.4490	0.4990	0.5840
5	0.6140	0.6810	0.6790	0.7400
6	0.3330	0.3940	0.4870	0.5520
7	0.7280	0.8620	0.9050	0.8750
8	0.5110	0.6050	0.6390	0.6730
9	0.4230	0.5140	0.6520	0.6470
10	0.6830	0.8170	0.8990	0.9550
11	0.8910	0.9310	1.0220	1.0880
12	0.9340	1.0900	1.2070	1.1720
13	0.5670	0.6570	0.7400	0.7770
14	0.5670	0.6380	0.6730	0.7350
15	0.4620	0.5230	0.4880	0.4950
16	0.8560	0.9340	0.8990	1.1510
17	0.7960	0.8460	0.8350	0.9630
18	0.9130	0.9820	0.9240	1.1570
19	0.7890	0.8760	0.8650	1.0400

Fig 3. Radiograph image of Manus bone

From the results of the bone genu radiograph with the specifications of the ZHIMADZU MODEL XUD 150L-30F. 150 kv 500mA obtained an example image in Figure 3.

From the image of the manus bone, then on the trabeculae of the little finger, texture feature extraction was carried out using the gray level cooccurance matrix method. The results of the texture analysis of the trabeculae of the little finger can be seen in table 2.

The textural values of the human bone image (Angular second moment, contrast, correlation, variance, inverse different moment and entropy) were then correlated with the BMD value of the lumbar spine in sections L1, L2, L3 and L4. The results of the correlation test are shown in table 3

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Table 2. Texture values of the little finger part of the manus bone using the gray level co-occurance matrix method

Texture Features	Value
Angular Second Moment	0.00 0.00 0.00 0.00 0.00 etc.
Contrast	122.64 125.58 115.41 135.90 34.59 etc.
Correlation	0.750 0.690 0.700 0.690 0.810 etc.
Variance	185.32 142.16 135.35 154.15 etc.
Inverse Different Moment	0.110 0.100 0.110 0.110 0.210 etc.
Entropy	10,650 10,560 10,510 10,530 9,320 etc.

Table 3. The results of the Pearson correlation test between texture values and BMD of the lumbar spine

Texture Value/ BMD	BMD L1	BMD L2	BMD L3	BMD L4
Angular Second Moment	r = -0.161	r = -0.142	r = -0.190	r = -0.225
	sig = 0.510	sig = 0.561	sig = 0.437	sig = 0.354
Contrast	r = 0.229	r = 0.171	r = 0.155	r = 0.223
	sig = 0.346	sig = 0.480	sig = 0.527	sig = 0.359
Correlation	r = 0.230	r = 0.299	r = 0.327	r = 0.286
	sig = 0.343	sig = 0.213	sig = 0.172	sig = 0.234
Variance	r = 0.452	r = 0.452	r = 0.467	r = 0.501
	sig = 0.052	sig = 0.052	sig = 0.044	sig = 0.029
Inverse Different Moment	r = -0.187	r = -0.140	r = -0.143	r = -0.197
	sig = 0.444	sig = 0.568	sig = 0.559	sig = 0.418
Entropy	r = 0.317	r = 0.289	r = 0.302	r = 0.358
	sig = 0.186	sig = 0.230	sig = 0.208	sig = 0.132

From table 3, it can be seen that the texture value at the angular second moment does not correlate with the values of BMD L1, BMD L2, BMD L3 and BMD L4 (P > 0.05). The contrast value also does not correlate with the values of BMD L1, BMD L2, BMD L3 and BMD L4 (P > 0.05). The Correlatian value also did not correlate with the values of BMD L1, BMD L2, BMD L3 and BMD L4 (P < 0.05). In the value of variance correlated with values, BMD L3 and BMD L4 (P < 0.05). The inverse different moment value does not correlate with the values of BMD L1, BMD L2, BMD L3 and BMD L4 (P > 0.05) and the entropy also does not correlate with the values of BMD L1, BMD L2, BMD L3 and BMD L4 (P > 0 ,05).

The correlation between the 'variance' value with the L3 section of the lumbar spine BMD was moderately correlated, and the variance value was also moderately correlated with the L4 section of the L4 lumbar spine BMD.

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Image Radiograph of the analyzed manus is part of the trabecular. Bone that is mostly composed of trabecular bone which means it has a greater bone surface and metabolic activity than cortical bone. Therefore, trabecular bone undergoes mineral changes more often so that it has a predisposition for bone mass deficiency.[11]

In postmenopausal osteoporosis patients, the number of trabeculae will decrease due to a reduction in the hormone estrogen which regulates the formation of collagen, non-collagenous protein matrix, and mineralization.[12] Changes that occur on the surface of the trabeculae until there is thinning of the trabeculae, reduced branching of the trabeculae, and expansion of the marrow area and if it continues, osteoporosis will occur.[13] This condition causes changes in the X-ray absorption conditions in the bone, resulting in variations in the contrast in the gray scale recorded in the image.

Extraction of texture features is a very important part to identify the condition of the bone. Many studies have been conducted to identify osteoporotic bones by analyzing the texture characteristics of bone images, one of which is the GLCM . method[14,15] GLCM method can be used to find the features of osteoporosis picture or not.[16] The combination of GLCM and RLM can be used to detect bone loss.[17] GLCM and SVM also on dental panoramic are also good for detecting normal bone and osteoporosis.[18,19]

This study reinforces previous research that there is a relationship between the value of the human bone texture image and the value of the BMD of the lumbar spine, so that detection through the human bone can also be used.

Conclusion

Texture values of Angular second moment, contrast, correlation, inverse different moment and entropy are not correlated with BMD of the lumbar spine.

Texture variance values correlated with BMD lumbar spine with moderate strength and statistically significant correlation ($p < 0.05$). So that the texture variance feature can be used to classify normal bone or osteoporotic bone.

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