

DIGITAL INFRARED THERMAL IMAGING IN OSTEOPOROSIS

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ABSTRACT

This study examined the relationship between bone mineral density and DITI in the diagnosis of osteoporosis.

An analysis was performed on the thermographic findings of 20 patients without osteoporosis, 20 with osteopenia and 20 with osteoporosis at the Kangnam Korean Hospital, KyungHee University, Seoul, Korea, from June 1998 to February 1999.

The osteoporosis was measured by LUNAR PIXI and the body temperature was assessed by DITI. Thermographic measurements were performed on 4 areas (acupuncture point: CV12, CV4, BL23 and BL26).

All data were coded for computer analysis and significances were tested by Duncan test. There was no significant difference in age among the three groups of patients.

DITI revealed the significant hypothermia ($p < 0.001$) on the osteoporosis patients compared with osteopenia and normal bone density patients.

It is believed that DITI may be a favorable alternative to the diagnosis of osteoporosis.

Key words: Osteoporosis, DITI, Bone density, Acupuncture point

Introduction

As our population ages the problems of age-related diseases are becoming more pressing. Osteoporosis is a major age-related disease, which today affects millions of people throughout the world. It is a major public health threat.

Osteoporosis is characterized by a reduced amount of bone, which leads to diminished physical strength of the skeleton and an increased susceptibility of fracture²⁾.

Multiple factors contribute to the occurrence of osteoporosis but the most important by far is the accelerated loss of bone which starts at the menopause in women and continues progressively with age^{1, 2)}. Osteoporosis is much more common in women than in men but the problem in men is by no means

insignificant.

In Oriental medicine, there is no medical term of osteoporosis, but the kidney governs the bone marrow and bones³⁾. If the kidney essence is strong, the bone will be strong. If the kidney essence is weak, the bone will be brittle. It can be seen on the background of kidney yang and kidney yin deficiency. A deficiency of kidney essence could be substituted for osteoporosis. Even though, osteoporosis is often called the "silent disease" because bone loss occurs without symptoms. But many osteoporosis patients complain of cold hypersensitivity and/or body coldness.

The aim of this study is to examine the interrelationship between measurement of bone density and body surface temperature.

Materials and Method

1) Patients

A total of 60 patients participated in this study. An analysis was performed on the thermograph findings of 20 patients without osteoporosis, 20 osteopenia and 20 with osteoporosis at Kangnam Korean Hospital, KyungHee University, Seoul, Korea, from June 1998 to February 1999.

2) Measurement of Bone Density

A bone density test measures bone mineral content. The most common bone density test is a DEXA (dual energy X-ray absorptiometry) test. Bone density was measured by LUNAR PIXI at the calcaneus. The WHO has defined osteoporosis based on a low bone density. Borderline low bone density is called osteopenia. Normal bone is T-score better than -1. Osteoporosis is T-score between -1 and -2.5. Osteoporosis is T-score less than -2.5.

3) Thermographic Measurements

Thermographic observations for this study were made using the Dorex DITI on 4 different acupuncture points: Chungwan (CV12), Kwanwon (CV4), Shinsu (BL23) and Kwanwonsu (BL26)⁴⁾ which are thought to be related to osteoporosis.

4) Statistics

All the results were statistically analysed using the Duncan test, to compare the mean body temperature of the three groups: normal bone density group, osteopenia group and osteoporosis group.

Results

1) Age Distribution

The mean age of normal bone density group was 50.9 ± 2.6 years old, osteopenia group 53.8 ± 4.6 , and osteoporosis group 51.2 ± 8.9 . There was no significant difference in age distribution among the three groups (Table 1).

Table 1. Age Distribution

Group	Mean age (years old)
Normal group	50.9 ± 2.6
Osteopenia group	53.8 ± 4.6
Osteoporosis group	51.2 ± 8.9

2) Correlation between Bone Density and DIT on CV 12 area

The mean body surface temperature of normal bone density group was $33.21 \pm 1.60^\circ\text{C}$, osteopenia group $31.07 \pm 3.32^\circ\text{C}$ and osteoporosis group $27.76 \pm 2.55^\circ\text{C}$. It revealed statistical difference between normal bone density group and osteopenia group and osteoporosis group, respectively (Table 2).

Table 2. CV 12 Area Surface Temperature according to the Bone Density

Group	CV12 temperature ($^\circ\text{C}$)	Duncan grouping
Normal	$33.21 \pm 1.60^{1)}$	A ²⁾
Osteopenia	31.07 ± 3.32	B
Osteoporosis	27.76 ± 2.55	C
F-Value: 22.41****		

1) Mean \pm Standard deviation

2) Means with the same letter are not significantly different at $\alpha=0.05$ level by Duncan test.

*: Statistically significant value by the analysis of variance procedure (****: $p < 0.0001$).

3) Correlation between Bone Density and DIT on CV 4 area

The mean body surface temperature of normal

bone density group was $33.36 \pm 1.62^\circ\text{C}$, osteopenia group $30.54 \pm 3.54^\circ\text{C}$ and osteoporosis group $27.08 \pm 2.42^\circ\text{C}$. It revealed statistical difference between normal bone density group and osteopenia group and osteoporosis group, respectively (Table 3).

Table 3. CV 4 Area Surface Temperatur according to the Bone Density

Group	CV4 temperature($^\circ\text{C}$)	Duncan grouping
Normal	33.36 ± 1.62^{11}	A ²⁾
Osteopenia	30.54 ± 3.54	B
Osteoporosis	27.08 ± 2.42	C
F-Value: 20.44****		

1) Mean \pm Standard deviation

2) Means with the same letter are not significantly different at $\alpha=0.05$ level by Dunca test.

*: Statistically significant value by the analysis variance procedure(****: $p < 0.0001$).

4) Correlation between Bone Density and DIT on BL 23 area

The mean body surface temperature of normal bone density group was $33.21 \pm 1.58^\circ\text{C}$, osteopenia group $31.09 \pm 3.53^\circ\text{C}$ and osteoporosis group $27.73 \pm 2.86^\circ\text{C}$. It revealed statistical difference between normal bone density group and osteopenia group and osteoporosis group, respectively (Table 4).

Table 4. BL 23 Area Surface Temperatur according to the Bone Density

Group	BL23 temperature($^\circ\text{C}$)	Duncan grouping
Normal	33.21 ± 1.58^{11}	A ²⁾
Osteopenia	31.09 ± 3.53	B
Osteoporosis	27.73 ± 2.86	C
F-Value: 22.43****		

1) Mean \pm Standard deviation

2) Means with the same letter are not significantly different at $\alpha=0.05$ level by Duncan

test.

*: Statistically significant value by the analysis variance procedure(****: $p < 0.0001$).

5) Correlation between Bone Density and DIT on BL 26 area

The mean body surface temperature of normal bone density group was $33.24 \pm 1.78^\circ\text{C}$, osteopenia group $31.08 \pm 3.39^\circ\text{C}$ and osteoporosis group $27.72 \pm 2.69^\circ\text{C}$. It revealed statistical difference between normal bone density group and osteopenia group and osteoporosis group, respectively (Table 5).

Table 5. BL 26 Area Surface Temperatur according to the Bone Density

Group	BL26 temperature($^\circ\text{C}$)	Duncan grouping
Normal	33.24 ± 1.78^{11}	A ²⁾
Osteopenia	31.08 ± 3.39	B
Osteoporosis	27.72 ± 2.69	C
F-Value: 21.19****		

1) Mean \pm Standard deviation

2) Means with the same letter are not significantly different at $\alpha=0.05$ level by Dunca test.

*: Statistically significant value by the analysis variance procedure(****: $p < 0.0001$).

6) Comparison of Body Surface Temperature of Normal Bone Density Group on Different Areas.

It did not reveal any statistical difference between the body surface temperature on CV12 and CV4 and BL23 and BL26 (Table 6).

Table 6. Body Surface Temperature in Normal Bone Density Group

Area	Surface temperature	Duncan grouping
CV12	33.21±1.60 ¹⁾	A ²⁾
CV4	33.36±1.62	A
BL23	33.21±1.58	A
BL26	33.24±1.78	A
F-Value: 1.33		

1) Mean ± Standard deviation

2) Means with the same letter are not significantly different at $\alpha=0.05$ level by Dunca test.

7) Comparison of Body Surface Temperature o Osteopenia Group on Different Areas.

It did not reveal any statistical difference between the body surface temperature on CV12 and CV4 an BL23 and BL26(Table 7).

Table 7. Body Surface Temperature in Osteopeni Group

Area	Surface temperature	Duncan grouping
CV12	31.07±3.32 ¹⁾	A ²⁾
CV4	30.54±3.54	A
BL23	31.09±3.53	A
BL26	31.08±3.39	A
F-Value: 0.12		

1) Mean ± Standard deviation

2) Means with the same letter are not significantly different at $\alpha=0.05$ level by Dunca test.

8) Comparison of Body Surface Temperature o Osteoporosis Group on Different Areas.

It did not reveal any statistical difference between the body surface temperature on CV12 and CV4 an BL23 and BL26(Table 8).

Table 8. Body Surface Temperature in Osteoporosis Group

Area	Surface temperature	Duncan grouping
CV12	27.76±2.55 ¹⁾	A ²⁾
CV4	27.08±2.42	A
BL23	27.73±2.86	A
BL26	27.72±2.69	A
F-Value: 0.30		

1) Mean ± Standard deviation

2) Means with the same letter are not significantly different at $\alpha=0.05$ level by Dunca test.

Discussion

Osteoporosis is a disease in which bones become fragile and more likely to break. If not prevented or if left untreated, osteoporosis can progress painlessly until a bone breaks. These broken bones, also known as fractures, occur typically in the hip spine, and wrist^{1,2)}

There are many factors that determine who w develop osteoporosis. The first step in prevention i to determine whether you are at risk, since not everyone is. The risk factors are: Being female, Thin and/or small frame, Advanced age, A family history of osteoporosis, Postmenopause, including early or surgically induced menopause, Abnorma absence of menstrual periods(amenorrhea), Anorexia nervosa or bulimia, A diet low in calcium, Use of certain medications, such as corticosteroids and anticonvulsants, Low testosterone levels in men, An inactive lifestyle, Cigarette smoking, Excessive use of alcohol and Being Caucasian or Asian^{1,2,5,6)}.

A comprehensive program that can help prevent osteoporosis includes: A balanced diet rich in calcium and vitamin D, Weight-bearing exercise, A healthy lifestyle with no smoking and limited alcoho intake, and Bone density testing and medication and when appropriate. Although there is no cure for osteoporosis, there are several medications that

slow, and sometimes stop, bone mineral loss^{2,6)}.

Although there is no medical term of osteoporosis in Oriental medicine, descriptions of many related conditions can be found. According to Nei Jing, "... The kidney-qi of a seven-year-old girl is strong, her hair changes and the teeth grow ...; reproductive viability begins at fourteen; ... at age forty-nine her Controlling Vessel weakens, her Supreme Thoroughfare Vessel wanes and menopause sets in ... the kidney governs the bone,...the kidney stores the qi of the bone and marrow," and "the kidney gives rise to bone marrow"⁷⁾. "The kidney is water, what it genders is in the bone. If the kidney does not produce, then the marrow will not fill the bones...If the kidney-qi is hot, the lumbus does not hold up...when water fails to overcome fire, the bone become vacuous, and the feet can not support the body"⁷⁾. It is firmly instilled in Oriental medicine that the kidney is closely associated with the bone and the reproductive endocrine system.

Herbal medicine has been used in the Orient and West for the treatment of menopause and the management of osteoporosis according to the theory of Oriental medicine. A function of kidney is to produce marrow and control bones. This function of the kidney is derived from the essence. Essence is the organic foundation for the production of marrow. Marrow in Oriental medicine is a substance which is common matrix of bones, bone marrow, brain and spinal cord. The marrow is the base for the formation of bone marrow which nourishes the bones. Thus the kidneys govern the bone marrows and bones. The kidneys have a yin and yang aspect. Even though these two aspects acquire a different meaning for the kidneys, kidney yin and kidney yang have the same root and they rely on each other for their existence. Kidney yin provides the material substratum for kidney yang, and kidney yang provides the heat necessary to all the kidney functions. Because they are fundamentally one, deficiency of one necessarily implies deficiency of the other. If kidney function is strong, the bones

will be strong⁸⁾.

Cai⁹⁾ and Cai et al¹⁰⁾ investigated the relationship between the mineral levels of the ulna and radius in two studies. The group with kidney-vacuity syndrome revealed significantly lower levels of bone mineral than the group that did not have kidney-vacuity syndrome. Chen et al³⁾ studied the association between postmenopausal osteoporosis and kidney-vacuity syndrome. They concluded that patients with kidney-qi-yin-vacuity syndrome were more likely to get osteoporosis than those with kidney-qi-vacuity syndrome or kidney-yin-vacuity syndrome.

The body temperature is deficient in the case of cold hypersensitivity or intolerance to cold because of a Yang deficiency. Herbal prescriptions to tonify kidney yin and kidney yang are used for osteoporosis. These medicines are estrogenic in function and are rich in calcium and other trace minerals are commonly used in the clinic to support healthy bones and calcium metabolism¹⁰⁾.

In order to examine the interrelationship between measurement of bone density and body surface temperature, we carried out this study. It was revealed that the body surface temperature on the areas of CV12, CV4, BL23, and BL26 are significantly inter-related to the occurrence of osteoporosis. These results do not conflict with the view of Oriental medicine.

Conclusion

According to the above results, it is concluded that the body surface temperature, cold hypersensitivity and/or body coldness, have a great effect on bone density among women. Also it is believed that DITI may be a favorable alternative for the diagnosis of osteoporosis.

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