Comparison of Bone Mineral Density with Pencil Beam and Fan Beam DXA Machine

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ABSTRACT

The bone densitometer is to investigate the bone mineral content and density for the osteoporosis assessment by using dual energy X-ray photons. For the clinical verification of the ISOL's OSTEO plus, the clinical study was performed with healthy and non-menopausal 30 female volunteers. The fan-beam DXA machine (Lunar, Expert) was chosen as a reference. After correlation analysis of their bone mineral densities, a strong correlation was obtained. From the results, it is claimed that the new forearm bone densitometer is clinically useful in osteoporosis diagnosis.

Keywords: Bone densitometer, osteoporosis.

1. INTRODUCTION

The osteoporosis is a bone disease that the bone mineral content decreases higher than normal rate. As being interested in the female and the old health, the osteoporosis also became one of the major dangerous diseases. Consequently the bone densitometer becomes an essential diagnostic device. To diagnose osteoporosis, many bone densitometry techniques have been developed utilizing radioisotope, X-ray generator and ultrasound etc. Among these, a dual-energy x-ray absorptiometry (DXA) has been known as the most advanced and accurate technique of bone densitometry.

Recently, in Korea, a new bone densitometer OSTEOPLUS was developed and commercialized by ISOL Technology Inc. It can measure osteoporosis on forearm easily. It utilizes a pencil-beam DXA that is simple, accurate and cheap. Furthermore, it gives the lowest dose to patients. For its clinical validation, the comparison study was performed between OSTEOPLUS and a proven DXA bone densitometer as a reference and the correlation analysis of their bone mineral density was made.

2. MATERIALS AND METHOD

A Comparison study was performed with the volunteers of the female patients who were diagnosed with bone densitometry in St.Mary's hospital in 2001. These volunteers were selected carefully according to following requirements.

First, their ages should be between 20 and 40 and non-menopausal to exclude the lack of female hormone. Secondly, their health status should be normal with height and weight as those of normal adults. And finally, they should have no records of thyroid disease and no medication of steroid pharmacy, since it is known that these diseases and drugs decrease the bone mineral density significantly. In addition, they also have no experience of bone fracture especially on forearm. After the cautious qualification, the remaining number of final volunteers was 30 patients.

As a reference machine, a fan-beam bone densitometer (Lunar corp., Expert) was used. With both of Osteoplus and reference machine, the bone mineral densities of forearm, specifically ultra distal and mid distal areas were measured. Their correlation and statistical significances were analyzed by the linear regression analysis.

3. RESULTS

For 30 volunteers, the results are plotted as shown in Fig.1 and Fig.2. For the measurement results of the ultra distal, they exhibited a relatively strong correlation r=0.9273 than mid distal, r=0.7294. By the linear regression analysis of confidence level of 95%, the significance probability were P= 7.793×10^{-14} for ultra distal and P= 5.681×10^{-5} for mid distal. Consequently, one may safely conclude that they are strongly correlated and statistically significant.

4. DISCUSSION

First of all, the results show OSTEO Plus has a tendency of lower bone mineral density than reference. It is thought that the magnification effect by fan-beam geometry of the reference machine result in higher densities than those of Osteoplus for the same patients.

And the both results demonstrate excellent correlations especially at the ultra distal area than mid distal. Since forearm is complicate site where both trabecular and cortical bone exist, so a slight mispositioning of measurement can lead to a non-negligible results at the site of mid distal.

5. CONCLUSION

In conclusion, the clinical efficacy of new forearm bone densitometer has been proved. Through this study, it is proven that a new bone densitometer can be an alternative of expensive whole-body machine.

Particulary, those measurements of forearm densitometer at the site of ultra distal demonstrated an excellent cross correlation coefficient as 0.927 with a reference machine.

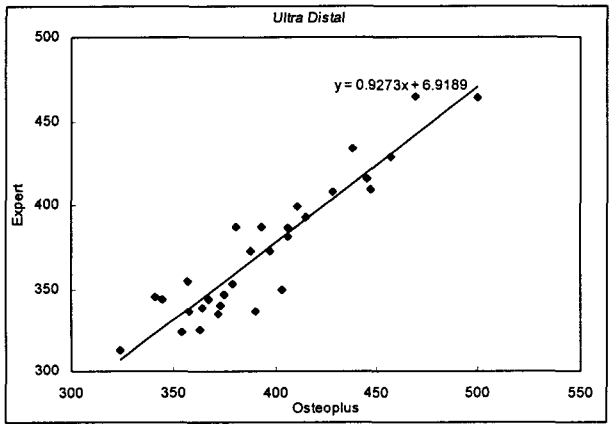

Fig. 1 Result of Ultra Distal analysis

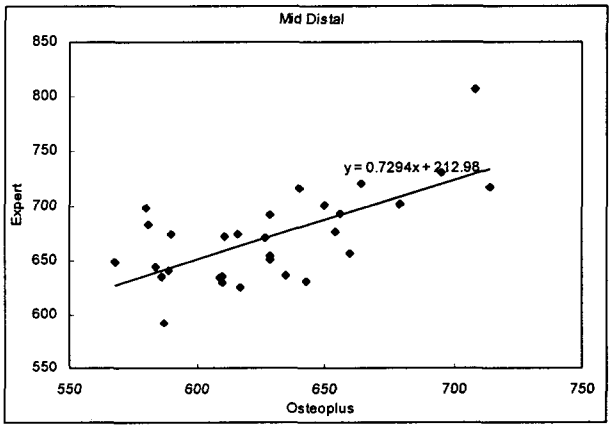

Fig. 2 Result of Mid Distal analysi