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Prediction of Osteoporosis using Soft Computing Techniques: A Review

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ABSTRACT

Osteoporosis is one of the unpredictable disease, in which the micro architecture of bones becomes weak due to the low bone mineral density. Today this disease is very common amongst old people aged more than 50 years. This common public health problem has no symptoms and only technique available to diagnose is dual-energy x-ray absorptiometry (DEXA) scan. Generally bone mineral density (BMD) can be measured using DEXA, which is compared against the standard BMD values for diagnoses. The availability of DEXA machine in a country like India is a serious issue, because of its high cost and the high percentage of population living in rural areas with limited health care facilities. Here, our aim is to detect this disease on the basis of patient's medical history without the necessity of DEXA scans report; so that it becomes feasible for the Indian population. For this proposed work will try to implement various Soft computing techniques which are available now- a- days.

I. INTRODUCTION

Low bone mineral density and loss of bone tissue may lead to weak and fragile bones which are characteristics of Osteoporosis disease. Osteoporosis results in fractures. Osteoporosis affects all bones in the body. However, fractures are most common in the hip, wrist, and spine. Normally, body recycles old bone components to make new ones, and it also deposits new calcium and other minerals into bone to make them tough and dense. But after the age of 35, bones stop growing and gradually lose bone density, which means that the tiny holes in them get larger while the hard substance gets thinner. So the bones become more porous, weaker, and more susceptible to injury and fractures. The result of bone mineral loss is that it affects the strength of skeletal system and causes problems with posture and with bone weakness. Generally, the clinical outcome of low bone mineral is fracture. In fact, for every one standard deviation below peak bone mineral, the risk of vertebral fracture is twice that of normal bone mineral, and 2.5 times that for the hip. To explain it in terms of an analogy, low bone mineral is to fractures, what high cholesterol or high blood pressure is to a heart attack. However, bone mineral loss is a natural part of human aging.

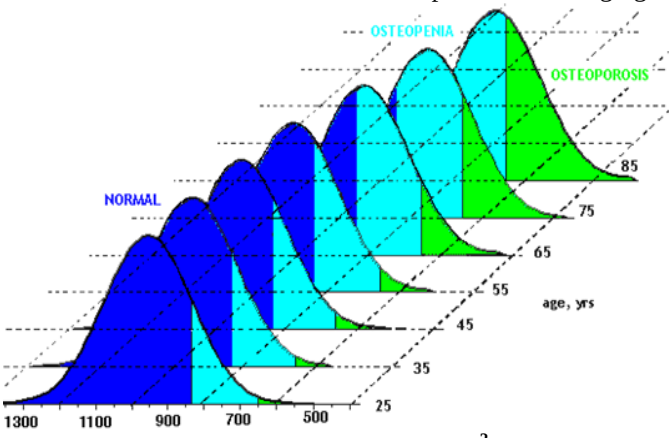

Fig 1. Standardized measures of (mg/cm^2) for Hip joint.

Preventive and treatment strategies can help to retain bone strength so that fractures are avoidable. Figure 1 shows the standard hip BMD in mg/cm2.

Bone Mineral Density can be given by the amount of minerals per square centimeter of bone, expressed in grams per milliliter. Higher the bone density, stronger the bone. Osteoporosis has become the epidemic now. Osteoporosis generally causes 8.9 million fractures per year worldwide. So to fight with this unpredictable disease without help of DEXA, proposed work use soft computing techniques and motivates to discover system having less cost.

II. LITERATURE REVIEW

Osteoporosis is a serious health problem because of the significant morbidity, mortality, and costs of treatment. It can strike at any age but it occurs most often in older people and in women after the age of 50. According to the International Osteoporosis Foundation (IOF) , 53.9% of women after age 50 have osteopenia (pre-osteoporosis) while 28.4% have osteoporosis and 21.9% of males aged 20-89 have osteoporosis in Egypt. IOF indicates that by 2020 up to nearly 25% of the population in Middle East countries will be over 50 years old, and will grow to 40% by 2050, as a consequence the osteoporosis infection rates will be increased in the future years [20]. Osteoporosis occurs when bones lose an excessive amount of their protein and mineral content, such as calcium. Over time, bone mineral and bone strength, is decreased. As a result, bones become weak and break easily. The most common sites of osteoporotic fracture are the wrist, spine, shoulder, and hip.

One of the traditional techniques is Singh Index (SI) in which the radiograph used to determine the extent of osteoporosis. It has much to do with the patterns seen in radiographic imaging of the bones. A typical SI describes the patterns of trabeculae in the bone at the top of the femur. These patterns categorized into six different scales or grades corresponding to the degree of bone loss as, grade 6 (normal), grade 4 (osteopenia), grade 3 (osteoporosis) and grade 1

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(severe osteoporosis)7. The problem with the technique is that no apparent change in the plain X-ray is seen until there is loss of about 40% of bone, which in many cases is too late [21].

In financially poor countries, due to the absence of DEXA machines, osteoporosis is diagnosed using X-Rays. Fracture risk requires that, if X ~ 3Y, the bone is deemed to be heavily osteoporotic. However, by this stage, it is too late to prescribe any medication that will reverse the disease, and the patient remains a high fracture risk candidate [5].

A WHO (World Health Organization) Scientific Group has done a lot of work to identify Osteoporosis and also tried to predict the risk. According to the report of a WHO Study Group meeting on Assessment of fracture risk and its application to screening for postmenopausal osteoporosis, osteoporosis has been recognized as an established and well-defined disease that affects more than 75 million people in the United States, Europe and Japan (1). [21].

Abdul Basit Shaikh et. al, worked on "Artificial Neural Network: A Tool for Diagnosing Osteoporosis" in which proposed system focused on use of Artificial Neural Network to detect osteoporosis efficiently[1].

Muhammad Sarim et. al, worked on "Bone Mineral Density Correlation against Bone Radiograph Texture Analysis: An Alternative Approach" in which they suggested use of x-ray radiographs to identify Osteoporosis[2].

Hui Li, Xiaoyi Li, Murali Ramanathan, and Aidong Zhang worked on" Prediction and Informative Risk Factor Selection of Bone Diseases" in which multi-tasking framework for osteoporosis that not only extracts the integrated features for progressive bone loss and bone fracture prediction but also selects the individual informative RFs that are valuable for both patients and medical researchers[3].

Walid Moudani et. al, worked on " Intelligent Decision Support System for Osteoporosis Prediction", in which Random Forest (RF) decision tree has been used to identify the osteoporosis cases[4].

Shalaka S. Abhyankar, Revati Shriram propose work on approach for measuring the cortical width of the lower border of the mandible below the mental foramen on panoramic radiographs is used to predict osteoporosis[6]. Ahmed M. Badawi implemented fuzzy rules and neural networks to identify osteoporosis[7].Neveen Ibrahim proposed Fosamax as a drug for osteoporosis[8].

Wenjia Wang, Sarah Rea done research in developing an ensemble of data mining techniques for predicting the risk of osteoporosis prevalence in women[9].

CONCLUSION

This paper is based on extensive literature survey on the topic prediction of Osteoporosis using soft computing techniques . The authors have presented a review here .Prediction of fracture risk and diagnosis of osteoporosis are the major concern of this era. The aim of this study is to review ANN in bone disease osteoporosis prediction .

Because of high costs and limited availability of DXA equipment it is worthwhile to look for alternative diagnostic techniques for osteoporosis. The purpose of this study is to obtain a possible means of early detection of osteoporosis by radiographic examination, which is simple, and affordable by public as well as cost effective .

The researchers here are working for early diagnosis and prediction of osteoporosis based on cost effective medical techniques using certain soft computing .This work is expected to be useful to the government as a preventive measure against osteoporosis as well as fracture risks.

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