

## Original Article

# Increased Bone Mineral Density in Cervical or Thoracic Diffuse Idiopathic Skeletal Hyperostosis (DISH): A Case-Control Study

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## Abstract

We aim to compare the bone mineral density (BMD) in a group of patients with cervical or thoracic diffuse idiopathic skeletal hyperostosis (DISH) with that in a matched control group. We also investigated the prevalence of osteoporosis in the two groups and determined the correlation between BMD and the extent of spinal DISH. From 1999 to July 2015, 65 patients with DISH underwent dual-energy X-ray absorptiometry at our institute. The control group was matched with regard to age, sex, and body mass index to the patient group on a 1:1 basis. BMD was measured at the lumbar spine (L1–L4), femur neck, and femur total areas using dual-energy X-ray absorptiometry. The BMDs of the DISH and control groups were significantly different at the lumbar spine (L1–L4) and the femur neck ( $p = 0.005, 0.001$ ). The rates of patients with osteopenia and osteoporosis were lower in the DISH than in the control group for the lumbar spine (L1–L4) ( $p = 0.05$ ). A positive correlation was observed between the lumbar spine (L1–L4) BMD and the number of spine levels affected by DISH ( $p = 0.04$ ). The BMDs of the lumbar spine and femur neck were found to be higher in the DISH group than in a matched control group, when patients with lumbar DISH involvement were excluded. The rates of osteopenia and osteoporosis tended to be lower in the DISH group than in the control group. Lumbar spine BMD is significantly correlated with the number of spine levels affected by DISH.

**Key Words:** Bone mineral density; case-control study; diffuse idiopathic skeletal hyperostosis; osteoporosis; spine.

## Introduction

Diffuse idiopathic skeletal hyperostosis (DISH), also known as Forestier's disease, is an idiopathic noninflammatory ankylosing skeletal disorder (1,2). It is a condition characterized by calcification and ossification of soft

tissue, mainly ligaments and entheses throughout the body, but most notably the anterior longitudinal ligament of the spine (3–5).

Several studies have analyzed bone mineral density (BMD) levels in DISH patients (6–12), but the findings remain controversial. Peripheral BMD was analyzed in three studies (6,7,11). Other reports, however, have shown that ossified ligaments affected lumbar BMD measurements (8,12). Therefore, lumbar spine BMD measurements may be affected in other studies in cases of DISH at the lumbar spine (10,12). A recent animal study showed that BMD was significantly low at the lumbar spine when DISH was

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involved at this level (13). In these previous studies, lumbar spine and femur neck BMD have not been clearly described in cervical or thoracic DISH patients when DISH was not involved at the lumbar spine.

In this study, we compared BMD levels in a group of cervical or thoracic DISH patients with those in a matched control group. We also investigated the prevalence of osteoporosis in those two groups and the correlation between BMD and the extent of spinal DISH.

## Materials and Methods

From 1999 to July 2015, 104 DISH patients underwent dual-energy X-ray absorptiometry (DXA) at our institute. BMD levels were measured by *T*-score. DISH was diagnosed with three-dimensional spine computed tomography (CT) or spine magnetic resonance image (MRI). The diagnosis of DISH was based on previously determined criteria by Resnick et al (5,14,15). These criteria are as follows: (1) flowing calcification/ossification along the anterolateral aspect of four contiguous vertebral bodies; (2) the relative preservation of intervertebral disc height in affected areas; and (3) absence of apophyseal joint ankyloses and sacroiliac joint sclerosis/fusion.

The extent of DISH was determined by the number of spine level with DISH. We reviewed images and medical records of these patients retrospectively.

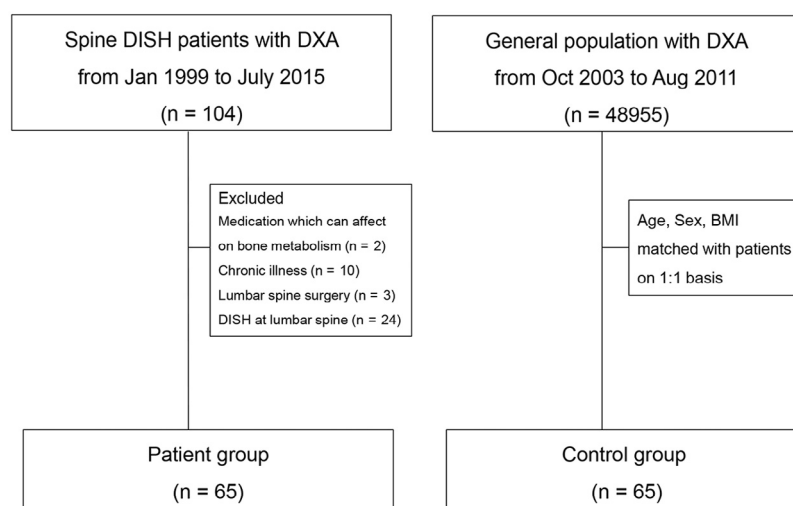
The control group in this study was selected from among the general population who underwent DXA from October 2003 to August 2011 as part of a routine health screening at the Healthcare System Gangnam Center, Seoul National University. The total number of those with DXA was 48,955; of these, a control group that was matched with DISH patients for age, sex, and body mass index (BMI) was selected on a 1:1 basis. Case-control matching was per-

formed independently by Seoul National University's Medical Research Collaborating Center (2015-0162).

We excluded patients and control individuals with potential confounding factors affecting BMD levels. The following were the exclusion criteria: (1) the reported use of synthroid, hormone-replacement therapy, or medicines for osteoporosis before DXA; (2) past or current medical history of cancer, thyroid disease, chronic renal failure, or chronic liver disease; (3) a history of bone surgery at the lumbar spine or hip; and (4) DISH involvement at the lumbar spine. According to these criteria, 39 patients were excluded. Sixty-five patients were included in this study. Accordingly, 65 controls were selected (Fig. 1). The mean ages of the DISH and control groups were  $73.2 \pm 9.4$  and  $72.3 \pm 8.7$  years, respectively. There were 48 males and 17 females in each group. BMI levels were also similar ( $24.2 \pm 3.2$  and  $24.2 \pm 3.1$ , respectively) (Table 1).

## Measurements of BMD

In both groups, BMD was measured at the lumbar spine (L1–L4), the femur neck, and the femur total areas using a DXA apparatus (GE Lunar, Madison, WI). BMD of the lumbar spine was measured in the standard anterior-posterior (AP) projection. The results are presented as BMD ( $\text{g}/\text{cm}^2$ ) and as *T*-scores. Individual *T*-scores were calculated by determining the difference between the measured BMD and the mean BMD of healthy young adults matched for sex and ethnicity, and then dividing this value by the standard deviation of the young adult population. In this report, the classification of osteoporosis followed the World Health Organization criteria (16). In that classification, a *T*-score below  $-2.5$  indicates osteoporosis, a *T*-score between  $-2.5$  and  $-1.0$  indicates osteopenia, and a *T*-score of  $-1.0$  or above indicates a normal BMD. The precision error (i.e., the coefficient of variation as a



**Fig. 1.** Inclusion and exclusion criteria of the diffuse idiopathic skeletal hyperostosis (DISH) patients and the control group.

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