## Original Research Article

# Relationship between the mandibular cortical index and calcaneal bone mineral density in postmenopausal women

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## ARTICLE INFO

## ABSTRACT

*Background and objective:* In clinical practice, a comparative analysis of bone mineral density (BMD) is carried out by examining different skeletal bones. This is useful for screening of postmenopausal osteoporosis (OP). The objective of this study was to determine the relation between the mandibular cortical index (MCI) and calcaneal BMD among postmenopausal women.

*Materials and methods:* The study sample included 129 randomly selected postmenopausal women aged 50–77 years. The participants were examined using panoramic radiography for the analysis of the cortical layer in the mandibular base for MCI determination and using DXL for the examination of calcaneal BMD. According to *T* scores, the subjects were divided into three groups (Groups 1, 2, and 3). The panoramic radiographic examination of the mandible was performed; the MCI was determined and distributed into groups (C1; C2; C3). The MCI validity in determining the calcaneus BMD status was analyzed.

*Results:* The differences in BMD were statistically significant between Groups C1 and C3 ($P < 0.01$), Groups C2 and C3 ($P = 0.01$), and between the calcaneal BMD groups ($P < 0.001$). There was a statistically significant inverse correlation between the MCI and calcaneal BMD ($r = -0.3$; $P < 0.001$). The changes characteristic of Group C2 were documented more frequently than those of other morphological groups. The analysis of the MCI validity in BMD status showed low sensitivity (69.4%) and specificity (53.9%).

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*Conclusions:* The relation between MCI and calcaneal BMD was determined. The diagnostic discrimination of the MCI was found to be not sufficient in screening the women with postmenopausal osteoporosis and its application in clinical practice might be limited.

## 1.    Introduction

Osteoporosis (OP) is a chronic disease that affects the bone tissue of the skeleton. It is common in a significant part of the elderly population, especially in postmenopausal women [1]. Progression of bone destruction occurs 5–10 years after menopause due to estrogen deficiency and increased levels of cytokines. During the first 5 years of the postmenopausal period, bone mass can be reduced by 20% (approximately 2%–3% of trabecular bone [TB] and 1%–2% of cortical bone [CB]) [2]. Due to the difference in the distribution of TB and CB, different remodeling takes place in different bones at different time. The areas with a higher amount of TB (e.g., spine, hip, calcaneus) are more susceptible to the development of osteoporotic processes, but bone changes and reduction also occur in those skeletal bones where the content of CB is high, e.g., in the mandible [3]. A comparative analysis of bone mineral density (BMD) is carried out in clinical practice by examining different bones due to uneven skeletal bone resorption [4]. Due to its availability and simplicity, panoramic radiography is a method frequently applied in dentistry, its significance in bone changing by OP has been adequately analyzed [5]. Scientific sources indicate that by analyzing CB of the mandible using panoramic radiographic images, it is possible to diagnose the total skeletal BMD reduction in up to 95% of cases [6]. In panoramic radiographic images, the mandibular cortical index (MCI) according Klemetti could be identified and it shows the solidity of the mandibular cortical bone layer at the base and the morphological changes occurring in the development of OP [7]. Some authors have reported that the index is useful for the screening of postmenopausal patients with osteoporosis and is well correlated with skeletal bone loss [8,9]. Other researchers discussed MCI efficacy and concluded that a large sample size was needed in order the index would be useful in BMD studies and that in other cases, it was not sufficiently precise for evaluation [5,10].

The relation of MCI to different skeletal bones (spinal, hip, hand phalanges) BMD has been investigated in a variety of scientific articles; however, the data on the interrelation between this index and calcaneal BMD are scarce [11–15]. Numerous studies of calcaneal BMD include its investigation using a quantitative ultrasound method (QUS) [13–15]. Calcaneal BMD can be studied using DXL Calscan, a mobile peripheral dual-energy X-ray and laser osteodensitometer. The device was approved for diagnostic testing in 2004 [16]. To our knowledge, there are no data concerning the determination of the relationship between calcaneal BMD using DXL and MCI in the postmenopausal female population.

Therefore, the aim of this study was to determine the relation between the MCI following Klemetti according to panoramic radiograms and calcaneal BMD, measured using a DXL Calscan osteodensitometer, in postmenopausal women.

## 2.    Materials and methods

The study was performed in the Institute of Endocrinology and the Department of Dental and Oral Diseases at the Lithuanian University of Health Sciences with the permission of the Regional Biomedical Research Ethics Committee (No. BE-2-13). Written informed consent for participation in the study was obtained from participants who were postmenopausal females at the age of 50–77 years. A questionnaire to collect data on the participants' age, usage of bone tissue metabolism preparations, causes and duration of the postmenopausal period, general disorders of the body that might affect bone tissue changes, and daily physical activity was employed. The inclusion criteria were good general health status, 1 year free of the use of bone metabolism-affecting medications, and no diseases leading to secondary OP, cigarette smoking, or alcohol abuse. The main exclusion criteria were lack of motivation to participate in the study, surgical treatment of the mandible, periodontal disease within previous 6 months, and edentulous mandible due to non-functioning mechanical load, as this may influence bone loss [17].

### 2.1.    Examination of BMD in the calcaneus

Calcaneal BMD was examined using DXL Calscan (P/N 031000; Demetech AB, Solna, Sweden). The device irradiation dose was 0.2 μSv. For examination, the participants were recommended to choose the calcaneus of a leg (left or right) without pain or previous fractures. The calcaneus was placed in the foot compartment of DXL Calscan. The software of the DXL Calscan device automatically calculated the region of interest (ROI) where calcaneal BMD had to be evaluated. The measurement results of bone mineral changes were graphically presented on the computer monitor. As the T-score determined during DXL Calscan examination met the criteria set by the WHO, the participants did not undergo any additional vertebral densitometry [18,19]. According to calcaneal BMD, the participants were divided into the following groups: Group 1, participants with normal BMD (T-score $>-1$); Group 2, participants with osteopenia (T-score $\leq-1$ to $>-2.5$); and Group 3, participants with osteoporosis (T-score $\leq-2.5$).

### 2.2.    Panoramic radiographic examination

Panoramic radiograms were performed the next day after the DXL investigation.