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Hand osteoarthritis and bone mineral density in postmenopausal women; clinical relevance to hand function, pain and disability

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Summary

Objective: The aim of the present study was to assess phalangeal bone mineral density (BMD) in postmenopausal females with hand osteoarthritis (OA) and to correlate the measured levels with the radiographic OA grade, pain, function and disability of the hand.

Methods: The study group constituted 40 postmenopausal women with hand OA (range; 45–83 years). Socio-demographic data were collected. They underwent a comprehensive clinical examination of joint status and health outcome measure including Australian Canadian (AUSCAN) OA hand index. Hand radiographs were quantified and graded according to Kellgren and Lawrence (K-L) scoring system. Bone mineral content (BMC) and BMD of the third finger were measured using the accuDEXA (Schick, New York, NY). Twenty females matched for age and years of menopause were studied as a control group.

Results: Phalangeal BMC and BMD were significantly reduced in women with hand OA compared to controls and related to radiological erosive OA. The AUSCAN pain and function subscales were worse in proportion to the severity of hand OA. OA X-ray score was significantly associated with reduced right grip strength, pain, and function scales while, decreased BMD was related to Ritchie index and pain scale.

Conclusion: Postmenopausal women with clinical and radiological hand erosive OA are at risk of development of hand osteoporosis (OP). Phalangeal bone densitometry is an objective reproducible investigation. Poor physical function due to increased pain associated with increasing severity of radiographic hand OA leads to worse BMD results.

Key words: Hand osteoarthritis, Osteoporosis, AUSCAN.

Introduction

Osteoarthritis (OA) is the most common age-related joint disorder throughout the world, and symptomatic hand OA is a leading cause of disability among elders[1]. It occurs in 60–70% of the population over 66 years of age[2] but a higher prevalence of radiographically diagnosed hand OA of 94.4% in women[3]. Hand OA may sometimes contribute minutely to pain and physical disability with limitations in performing activities of daily living[4], which could reach the same disabling levels induced by rheumatoid arthritis[5,6]. In spite of this, evaluation of hand OA has received little attention in the clinical setting.

The association between osteoporosis (OP) and OA remains partially unclear even after years of research since the first results indicate an apparent inverse relationship between these two common diseases[7]. Several cross-sectional studies showed associations between higher bone mineral density (BMD) and increased risk of developing radiographic hip and knee OA in elderly women[8,9], and hand OA in pre- and peri-menopausal women[10]. On the other hand, others showed decreased femoral BMD[11] and lumbar spine osteoporosis[12] in postmenopausal women with clinical hand OA. Despite these findings, limited information is available on the association between different grades of OA and bone mineral mass[13,14]. Dual X-ray of the hip and spine is the 'gold standard' for diagnosis of OP. Within the limitations of single site measurements, reports from conducted studies have proved that bone densitometry examined by accuDEXA, which measures BMD in the finger was strongly correlated with BMD of the hand and forearm[15]. It has adequate sensitivity to identify women with low BMD at the femoral neck[16]. Therefore, we hypothesized that phalangeal bone mineral content (BMC) and BMD are indicators of cortical bone mineral mass. The aim of the present work was to assess phalangeal BMD in postmenopausal females with hand OA and to explore the relationship of BMD levels with the radiographic OA grade, hand pain, function and disability.

Patients and methods

PATIENTS

Forty postmenopausal women between the ages of 45 and 83 years presenting with hand OA were enrolled into this study. They were all diagnosed based on the American College of Rheumatology criteria for classification of hand OA[17]. Twenty healthy volunteers constituted of postmenopausal women without clinical and radiological signs of

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hand OA matched for age (56.55 ± 6.49 years) and years since menopause (8.35 ± 5.26 years) served as controls. An informed consent was taken before the study.

EXCLUSION CRITERIA

Patients with De Quervain's, palmar tenosynovitis, trigger finger and Dupuytren's contracture of hand and wrist were excluded. Also patients who had previous orthopedic surgery or fracture, secondary OA (post-traumatic, metabolic, and inflammatory rheumatic disease) were excluded from the study. None of our patients were on hormone replacement therapy or on any other form of treatment for OP. None was a smoker or an alcoholic.

Methods

OUTCOME MEASURES

Socio-demographic and clinical data were collected at the time of enrollment into the study. Patient's formal education (years), occupation, current or past activities involving intensive use of the hands such as lifting or carrying heavy objects, handedness, and parity (number of children) were noted as well. At initial evaluation, the height and weight were measured and body mass index (BMI) in kg/m^2 was calculated as an estimate of relative weight. All patients were subjected to health assessment questionnaire; Australian Canadian (AUSCAN) OA hand index. The AUSCAN[18] is a disease-specific health status measure for hand OA capturing pain (five items), stiffness (one item) and difficulties with daily activities (nine items). The Likert-scale version (0–4) was used in this study within each of the 15 items[19]. Articular index; tenderness at carpo-metacarpal, metacarpo-phalangeal and proximal inter-phalangeal joints of the thumb; proximal inter-phalangeal and distal inter-phalangeal joints of the fingers in both hands were measured using Ritchie scores[20] (0–3). The score for each joint ranged between 0 (absence of pain) and 3 (pain associated with withdrawal movement), range (0–72) for both hands. Grip strength (mm Hg) in a standardized way (as the best performance out of three attempts on each hand) and duration of morning stiffness (min) were measured.

RADIOLOGICAL ASSESSMENT

Each subject had postero-anterior plain radiographs of both hands at the time of evaluation. Hand radiographs were all reviewed by two trained readers. Radiographs were graded according to the criteria described by Kellgren and Lawrence (K-L)[21] radiological score as illustrated in their Atlas of Standard Radiographs, Fig. 1. The intra-observer reliability correlation coefficient κ (kappa statistic) was 0.79 for reader 1 and 0.82 for reader 1; correlation coefficient κ for inter-observer reliability was 0.65 for radiographic scoring. OA grades were assigned into grade 0 = no OA, grade 1 = doubtful OA, grade 2 = minimal OA, grade 3 = moderate OA, and grade 4 = severe OA. Definite hand OA was diagnosed with a grade ≥ 2.

BONE DENSITOMETRY

The BMD of the middle phalange of the third finger (g/cm^2) was measured using the accuDEXA (P/N B7123100) (Schick, New York, Long Island City, NY). The accuDEXA device utilizes dual-energy X-ray absorptiometry (DEXA) technology, the standard of bone densitometry, designed also to assess BMC of the imaged portion of the finger (g), Fig. 2. All accuDEXA exams are performed on the non-dominant hand and analyzed by the same investigator. Proper finger placement inside the hand slot is essential for precise test. The QC Phantom Test is an additional quality-control check of the accuDEXA system. Reference BMD is calculated from results of the first 10 phantom tests; to be included as one of the first 10 tests, the phantom BMD must fall within 0.52–0.58 ranges. The precision in clinical subjects is within 1%. The accuracy error (Standard Error of the Estimate [SEE] = 1.8%) is lower than other peripheral and axial techniques. The *t*-score and *z*-score are calculated in the accuDEXA software compared with a normative database of other individuals with the same age, gender, and Caucasian ethnicity. The *t*-score was calculated according to the equation given by the manufacturer: $BMD_{patient} - BMD_{young\ healthy\ normal}$/standard deviation (SD). The *z*-score is calculated as follows: $BMD_{patient} - BMD_{Age}$/SD. The analysis is calculated automatically based on *t*-score, and reported as normal (1 SD $\geq$ *t*-score ≥ -1 SD), osteopenia (-1 SD $>$ *t*-score > -2.5 SD), or osteoporosis (*t*-score < -2.5 SD) according to the WHO guidelines[22]. The *t*-score and *z*-score for the scanned patient

Fig. 1. Hand X-ray showing narrowed proximal interphalangeal with asymmetric narrowing of the distal interphalangeal joints of the middle finger. Subluxation of the metacarpo-phalangeal and first carpo-matacarpal joints.