Protocol

This cross-sectional study sample included 127 postmenopausal women aged 52–91 years (mean age, 70.4 ± 8.9 years) enrolled from the RSU Institute of Stomatology who attended the clinic between October 2017 and November 2018. Patients were included if they agreed to participate, which was recorded in an informed consent form. The study was approved by the Riga Stradins University Ethics Committee (Nr. 28/05/10.2017). The study protocol adhered to the tenets of the Declaration of Helsinki.

Inclusion and exclusion criteria

Patients with diseases and conditions leading to secondary osteoporosis (renal diseases, hyperparathyroidism, Cushing's syndrome, thyrotoxicosis, rheumatoid arthritis, organ transplantation, diabetes, etc.) and women with early menopause (before the age of 45 years) or menopause caused by surgery were excluded from the study. Women who were taking medicines that are known to affect bone metabolism (glucocorticoids, bisphosphonates, strontium ranelate, selective estrogen receptor modulators, hormone replacement therapy, calcitonin, active vitamin D metabolites, teriparatide, etc.), except calcium (at doses less than 1000 mg/day) and vitamin D (at doses less than 800 IU/day), currently or one year before the start of the study were also excluded from the study; in addition, smokers and people who consumed excess alcohol (more than 14 alcohol units per week) were also excluded.

Dual-energy X-ray absorptiometry

The BMDs of the lumbar spine (L2-L4) and both femoral necks (total hip mean) were obtained by DXA (Lunar DEXA DPX-NT; GE Medical Systems, Waukesha, Wisconsin, USA). DXA examinations were performed by a single experienced specialist within two months of the

CBCT examinations. The worst T-scores (the number of standard deviations above or below the mean for a healthy 30-year-old adult of the same sex and ethnicity as the patient) for both assessments were taken into account. Patients were stratified into three groups according to DXA results: normal BMD (T-score ≥ -1.0), osteopenia (T-score from -1.0 to -2. 5), and osteoporosis (T-score ≤ -2.5).[3] The patients' height and weight were measured at the time of the DXA scans. Body mass index (BMI) was calculated by dividing the patients' mass in kilograms by square height in meters (BMI = weight in kg/[height in m]^2).

CBCT examinations

The study included patients who underwent CBCT investigations during their dental implant treatment at RSU Institute of Stomatology with the same equipment (i-CAT Next generation; KaVo Dental GmbH, Germany, Imaging Sciences International, Hatfield, PA) with the following scanning protocol: tube voltage, 120 kVp; tube current, 5 mA; exposure time, 4 seconds; voxel size, 0.3 mm; and FOV, 230 × 115 mm.

CBCT measurements

The angulations of selected slices were adjusted manually to reduce differences in head position among the participants. This adjustment was performed according to the method described by Barngkgei et al.

The axial, sagittal, and coronal CBCT images were reconstructed from block images using OnDemend3DTM (Cybermed Inc, Seoul, Korea). In the Dental Module system, the MPR view was used for measurements. For all patients, the window level and width were adjusted to GVs of 1077 and 4083, respectively. The sagittal slice for measurements was chosen in the middle of the second cervical vertebra, where the second vertebrae were the longest (combining the body and the odontoid process of the second cervical vertebra). GV measurements were

performed in the middle of the bodies of the second and third cervical vertebrae in the region of interest (ROI, 23 × 23 mm) . Axial slices were obtained using the axial CBCT images in the middle of the second and third vertebrae. In these axial slices, ROIs (23 × 23 mm) were created and GV measurements were performed**.** The average GV from each ROI was used for further analysis. If measurements for a certain ROI were impeded by artifacts, then the measurement was not performed and those data were not included. All measurements were performed by a single experienced observer who performs CBCT examinations routinely, on an LCD monitor with a resolution of 1920 × 1200 (single 24.1' LG monitor FlexScan S2202W; EIZO, Nano Corporation, Japan). To determine measurement agreement, 25% of the measurements for the second cervical vertebra were repeated after 2 weeks.