

CARDIOVASCULAR PATTERN IN HIP OSTEOPOROSIS ETIOPATHOGENY- A SILENT DENTAL RISK –

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ABSTRACT

Aim of the study The purpose of the study is to investigate whether bone quality information obtained by CT, could provide valuable information about the health of the patient's bone system, the cardiovascular one and, implicitly dental status and treatment risks. **Materials and methods** Radiologic views were enrolled from the archive system of the radiology department. We focussed on a group of 54 patients diagnosed with osteoporosis and cardiovascular pathology, admitted to the "St. Spiridon" County Clinical Emergency Hospital, Iasi. All the patients underwent CT angiography for their underlying pathology. **Results** The results showed that bone density of the femoral head, measured by this direct method, can give important information about the existence of a degree of bone demineralization. Corroborating the two CT techniques for measuring bone density, with the highlighting of the periarticular vascular system, brings measurable and certain data on the state of health of the entire cardiovascular system. The direct measurement of the acetabular density, as cancellous bone, still requires extensive studies in order to be edified as a study method. Age and pathology-related changes in vascular morphology, studied by means of radiology provide an important contribution to the literature. **Conclusions** the dental practitioner must take into account the possibility that two entities with great potential risk for health and oral treatments can coexist in different non-diagnostic forms and amplify these problems.

Key words: dental health, atherosclerosis, vascular imaging, osteoporosis

INTRODUCTION

In dental practice, we meet patients with various systemic diseases, most of which are cardiovascular diseases (CVD). The interrelationship between oral health and heart disease has been well established. The most common CVDs are hypertension, heart failure, ischemic heart disease, cardiac arrhythmias, infective endocarditis, stroke and pacemaker. This category of patients still represents a significant challenge for dental therapy. Based on BCV expertise, an appropriate and individualized modification of dental care is necessary as well as a multidisciplinary approach that can improve the results of dental treatment (1).

Osteoporosis is associated with several risk factors, and increasing evidence suggests

that it may be associated with oral health conditions such as periodontal disease, reduced jaw bone density, and tooth loss. At the same time, in addition to the effects of osteoporosis on oral health, osteonecrosis of the jaws associated with bisphosphonates is a major concern for the dentist (2).

At the same time, there is a special category of patients with CVD and/or osteoporosis - those who have one of these diseases but have not been diagnosed until now.

Degenerative diseases are a frequent cause of death and disability, especially in recent decades when life expectancy has increased due to advances in medicine and improved living conditions. Thus, conditions such as osteoporosis (OP) and cardiac vascular disease (CVD), very common among the

elderly and with a great negative impact on the quality of life, have a high social relevance. Osteoporosis and cardiac vascular disease are the two most common diseases in elderly individuals. They are associated with significant risks for morbidity, mortality and disabilities [3, 4]. In the USA, OP affects around 44 million people (55%) over the age of 50 years [5, 6]. Meanwhile, regarding the increased lifetime expectancies according to data from the World Health Organization (WHO) considers that elderly individuals will comprise 20% of the population by 2050 [7-9]. OP is an extremely common disease, which affects approximately 200 million women worldwide and is associated with a high fracture rate. 1 in 3 women over age 50 and 1 in 5 men over age 50 will experience a fracture on the osteoporotic bone [10].

The two clinical entities, cardiovascular disease and osteoporosis were previously considered age-related but independent diseases. They are interconnected by common risk factors - aging, lack of activity - and occur in the same individuals [11, 12].

Recent studies suggest a possible relationship between CVD and subclinical atherosclerosis closely related to low bone mass density (BMD) and of course, increased fracture risk [13-16]. This relationship has been proven to exist also vice versa - BMD is related nowadays to increased cardiovascular risk [17-19]. These pathologies share their pathogenesis, such as the factors that influence bone metabolism which are involved in the development of CVD. These factors consist of atherosclerosis and vascular calcification caused by bone-related proteins involved in the calcification process [20-22]. This is important because the calcification of the arterial walls could work as a marker for CVD and could be used to identify patients at risk for CVD, as well as fractures.

More and more nowadays it is

discussed about circulating osteogenic precursor cells (COP), which constitute a population of circulating progenitor cells with the ability to form both bones and other mesenchymal tissues. Being a recent discovery, there are still many contradictions and uncertainties regarding these cells.

COP is currently known to exist in the fraction of peripheral blood mononuclear cells (PBMC) of the blood, in a proportion of approximately 0.42% [23]. These cells appear to circulate at a constant level throughout life in healthy individuals, and their formation intensifies during periods of accelerated bone growth [24, 25].

Also, COPs closely resemble mesenchymal stem cells (MSCs), which are usually classified as plastic adherent, capable of multilineage differentiation and logarithmic proliferation, expression of cell surface markers, CD105, CD73, CD90, and do not express markers hematopoietic CD34, CD45 and CD14 [26].

Although numerous studies have been done on these markers, applied to COP, the characterization of these cells varies significantly depending on their origin, marker expression, plastic adhesion, morphology, homing mechanism, differentiation and proliferative potential [27].

Among the cells involved in the regulation mechanisms of bone growth and homeostasis, osteoblasts were identified on its external surface. Initially it was not clear where they come from and how they are regenerated, these cells not being able to undergo mitotic division. Osteoclasts were discovered in circulation in the 19th century [27] and were thought to be osteoblasts that fused with a neighboring chondrocyte. From this connection came the idea of a circulating osteoblastic progenitor cell. A long time after this discovery, researchers stimulated histiocytes to osteogenesis by autoinduction, and then demonstrated the fact that

heterotopically transplanted bone marrow is capable of forming both blood and elements bones. Thus, a source of progenitor cells of the mesenchymal and hematopoietic lines was identified [29]

In an attempt to demonstrate the connection between the two major pathologies, a physiopathological association was found through common regulatory mechanisms, so that the bone mineralization process is similar to the precipitation and absorption mechanisms of calcium and phosphate involved in the formation of calcified atherosclerotic plaques [16]. Also, the pathophysiological link is supported by the effects that the medications exert: the medication used in the treatment of osteoporosis to slow down the progression of the disease, such as bisphosphonates, has beneficial effects in terms of slowing down the osteoporosis process, as well as the use of statins in the treatment of cardiovascular diseases seems to decrease the incidence of osteoporotic fractures [30, 31].

Current studies report emerging data highlighting the common mechanism of both conditions. Thus, the metabolism of bone proteins such as osteocalcin and osteoprotegerin is also closely related to the etiopathogenesis of cardiovascular disease and this is of particular interest. Moreover, recent data suggest the involvement of bone metabolism in the regulation of energy balance, which may play a key role in triggering cardiovascular disease [32].

The close link between osteoporosis and atherosclerosis has been intensively studied, and a recent study conducted on a group of patients who had atherosclerosis changes in a single lower limb demonstrated that the bone structures of the lower limb affected by atherosclerosis (femur, ankle and leg) have lower bone density than those from the contralateral, healthy leg [33].

Atherosclerosis and vascular

calcification produce poor blood supply and alter the metabolism of bone tissue, inducing an acceleration of the rate of demineralization. Current studies support low arterial flow as a very strong factor in the development of osteoporosis, stronger even than female sex or advanced age. Also, patients with damage to the arterial vascular system of the lower limbs have a higher risk of falling. They have low muscle strength and a high prevalence of peripheral neuropathy, and a large number of them develop a sedentary lifestyle and low exposure to light of the sun, which leads to a decrease in the level of vitamin D [34, 35].

The atherosclerosis process affects the entire circulatory system, including the coronary arteries, having a major impact at this level. Myocardial infarction represents a major public health problem, being associated with increased morbidity and mortality, and current studies support a close association of coronary artery disease with osteoporosis. Patients with low bone density have a higher prevalence of developing coronary diseases than patients without osteoporosis, and self-reported myocardial infarction was increased by 22% in women with low bone mineral density and by 39% in men with low bone mineral density. Both of them are pathologies related to advancing age and share common risk factors that influence both the atherosclerosis process and bone homeostasis, factors such as menopause, advanced age, female sex, but also oxidative stress, and dyslipidemia. inflammation or hyperhomocysteinemia. Moreover, a more obvious link between osteoporosis and coronary artery disease is represented by the number of intriguing common features in the physiopathological chain [34]. The process of forming atherosclerotic plaques is not a passive one, strictly related to the aging process, but one regulated by mechanisms similar to those involved in bone mineralization. The formation process of calcified atherosclerotic plaques

was the subject of many studies that demonstrated its complexity, being a highly controlled mechanism. Cytokines, enzymes, hormones and genetic factors involved in the transport and metabolism of calcium and phosphate and the generation of osteoblastic cells from vascular smooth muscle cells were highlighted in the chain of regulation of this process [37].

In the list of benefits brought by the discovery of a close connection between cardiovascular diseases and osteoporosis, the possibility of developing a strategy for the prediction and early diagnosis of the two pathologies is also included [38]. Regarding this, a more thorough evaluation of the cardiovascular system by an exercise test and a Doppler ultrasound examination could be useful in exploring people diagnosed with osteoporosis, as well as the introduction of dual-energy absorptiometry examination in the standard examination package for patients with cardiovascular disease [38, 39].

During the decade of years, studies showed that CT images of the femoral head may serve as an easier target for measurement, particularly since Hounsfield Unit (HU) value measurements could easily be performed with a single spherical region of interest (ROI)[40].

The purpose of the present study is to investigate whether bone quality information obtained by CT, without the use of software or post-processing from an area where radiologists or clinicians can easily make measurements, could provide useful information about the health of the patient's bone system and, implicitly the cardiovascular one. Due to the widespread of the equipment and its entry into the routine use of clinicians in any field, CT has the potential to easily become an opportunistic method of investigating bone density, at different levels of the body.

MATERIALS AND METHODS

Radiologic views were enrolled from the archive system of radiology department. We focused on a group of 54 patients diagnosed with osteoporosis, admitted to the "St. Spiridon" County Clinical Emergency Hospital, Iasi. Our study group consisted in 10 men and 44 women, aged between 49 and 85 years old. For these patients, we also recorded data related to gender, personal and hereditary antecedents, as well as radiological evidence of osteoporotic disease. The proportion of men/women diagnosed with osteoporosis was greater than 1/4. At the same time, the average age of male patients diagnosed with osteoporosis is 53 years and of female patients 68.

All the patients underwent CT angiography for their underlying pathology. The device used was a Philips Incisive 128 slice CT scanner (Incisive 128 slice, Philips, Eindhoven, the Netherlands) and angio-CT examinations were performed on the abdominal aorta and arterial main axis of the lower limbs.

Exclusion criteria considered patients with femoral head pathologies (such as tumors, necrosis, bone marrow infiltrating disease); patients with hip orthopedic implants or prosthesis, and patients with contrast enhanced abdominal pelvic and pelvic CT.

CT data analyzed were performed using YaDiV®, Welfenlab, Hannover, Germany39 program. The scans were acquired at 120 kVp, using a large field of view, and had a slice thickness in the range 1.0 to 2.0 mm. The same type of intravenous contrast enhancement was used in the scans - Iopamiro, 370 mg/ml.

We quantified osteoporosis using Hounsfield units (HU), patented in a recent study [26]. We considered that the cut-off values for osteoporosis should be 204 HU for right hips and 198 HU for left hips, values measured at the level of the femoral head.

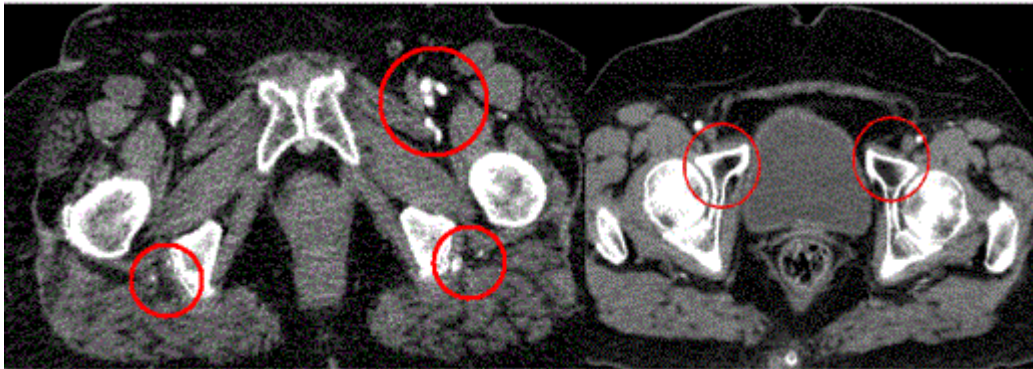


Figure 1. Acetabular demineralization with anterior predominance (on the right) in a 51-year-old woman with associated cardiovascular diseases and periarticular vascular calcifications (on the left)

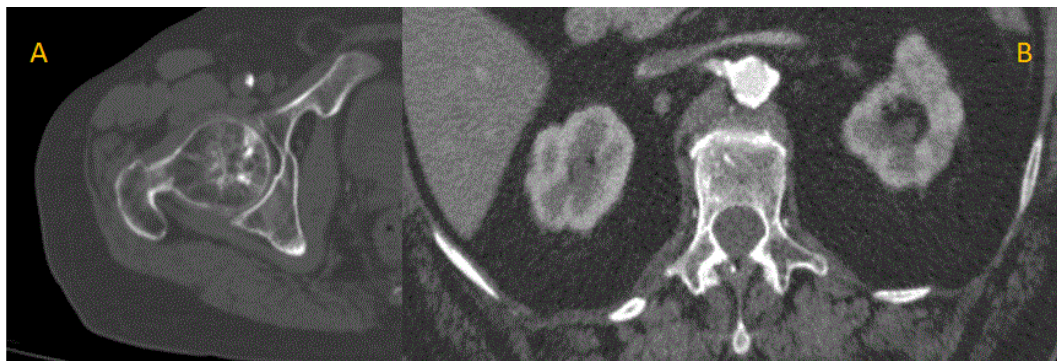


Figure 2. Significant iliofemoral bone demineralization (A) in an 82-year-old woman with peripheral arterial disease and calcifications on the abdominal aorta (B), common iliac arteries and external iliac arteries

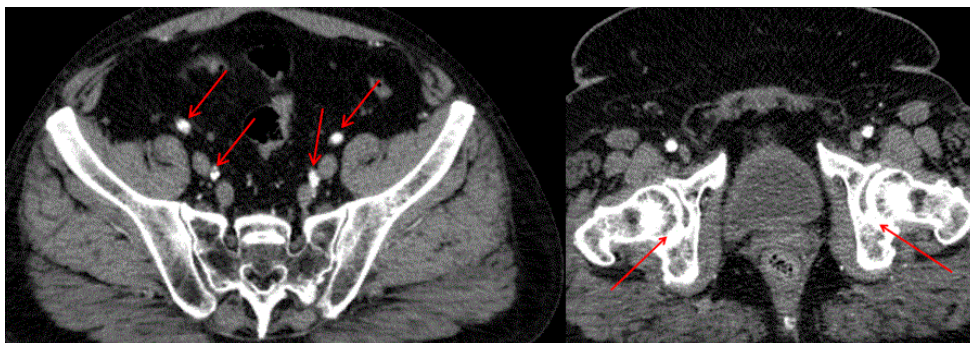


Figure 3. Significant arteriosclerotic signs on internal and external iliac arteries (left image), on both sides, correlated with coxarthrosis and mild acetabulofemoral demineralization (right image) in a 68-year-old woman with peripheral arterial disease and acute myocardial infarction in the past

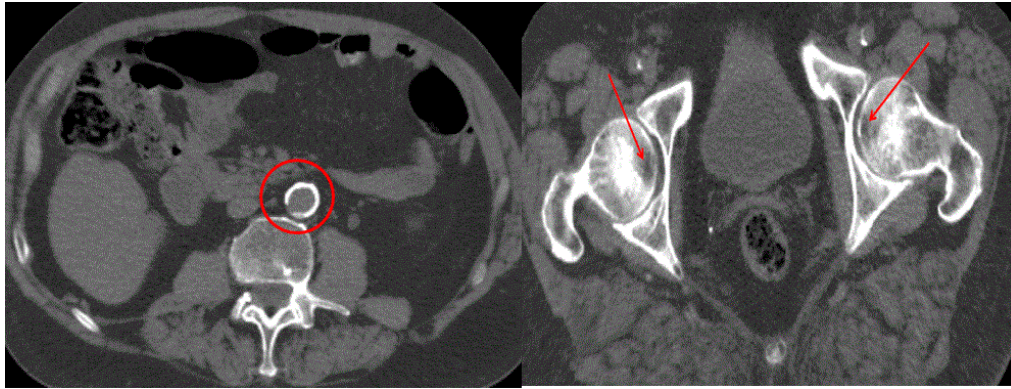


Figure 4. Annular calcifications of the abdominal aorta, right below the origin of the renal arteries (left), correlated with apical necrosis of the femoral head (right) and bone demineralization in a 72-year-old woman

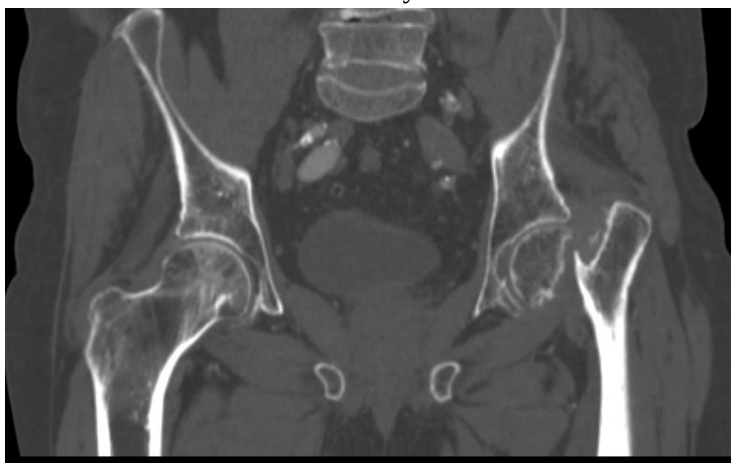


Figure 5. Old left femoral neck fracture, consolidated, with pseudarthrosis and significant bone demineralization in an 82-year-old woman

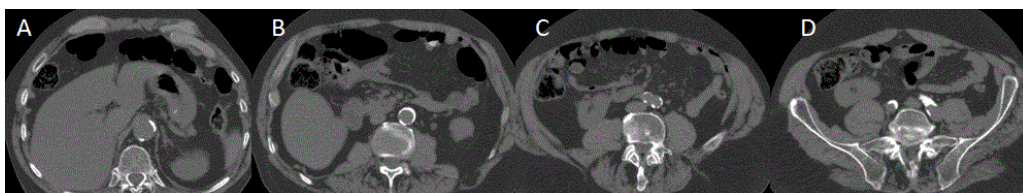


Figure 6. Tiered arterial calcifications of the abdominal aorta (L3 - A; L4 - B), at the level of the bifurcation of the aorta (c) and at the bifurcation of the left common iliac artery, in the case of a patient with a vicious consolidated femoral neck fracture, in the case of a patient with a vicious consolidated femoral neck fracture, 80-year-old man - native MRI

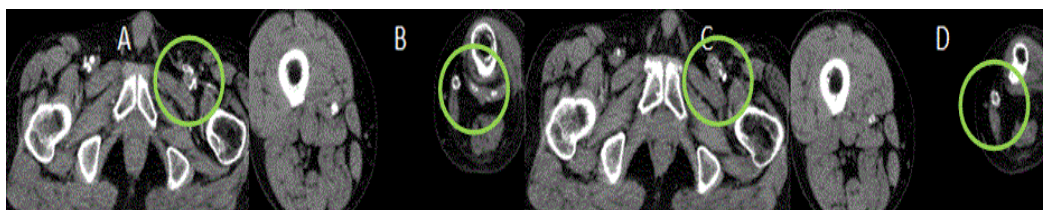


Figure 7. Annular appearance of the external iliac artery, at the origin (A - MRI with contrast substance), calcifications at the level of the perifemoral arterial circle, at the level of the femoral neck (B - native MRI), Calcifications of the left femoral artery, at the origin (C - native MRI) and annular appearance of the left femoral **artery** in Hunter's canal, in

the case of a patient with a vicious consolidated femoral neck fracture, 78-year-old man.

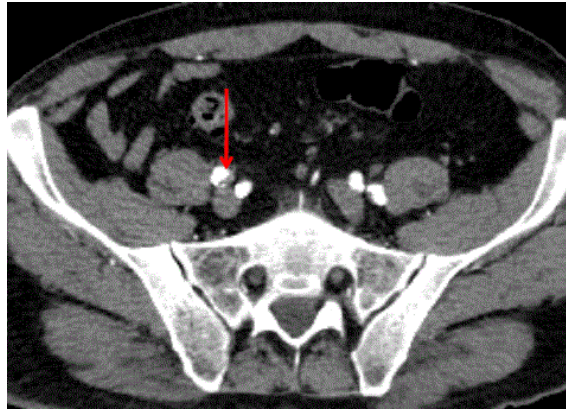


Figure 8. Obliterant arteriopathy of the right external iliac artery in a 72-year-old man with osteoporosis



Figure 9. Arteriopathy at the level of the bifurcation of the common iliac arteries in a 72-year-old woman

RESULTS AND DISCUSSIONS

The patients from our study had associated pathology but hypertension was a common issue of all of them, in advanced stages. Besides this pathology, most of them presented associated cardiac pathology and some of them cerebrovascular pathology either (Table 1). All patients in the study group presented a form of arteriosclerosis of the lower limbs (Table 2.).

The osteoporotic damage of the patients is also different. Some of them show acetabular or femoral head demineralization (Figure 1, Figure 2). Some of the patients have arthrosis at the level of the coxofemoral joint (Figure 3, Figure 4) and others fracture of the femoral head or neck, with vicious consolidations (Figure 5, 6, 7).

All investigated patients present various degrees of atherosclerosis associated with decreased bone density at the level of the femoral head, bilaterally and possibly at the acetabular level. Among these, the most frequent association is with cardiac, myocardial or valvular pathology and arteriosclerosis at different levels of the body or tiered.

Of the 54 patients included in our study, 85,18 % (46) have HU values below the proposed cut-off values for osteoporosis at the level of the left femur and 92.59 % (50) at the level of the right femur. In women, the average value of the density measured in HU was 172 on the right and 160 on the left, while in men it was 184 on the right and 165 on the left.

The more important the atherosclerotic damage that patients present, the lower their

bone density (Figure 8, Figure 9). The bone mineral density is not uniformly distributed at the pelvic bones, having different HU values in various segments, effect of load on development and maintenance of bone mass and strength.

The computed tomography evaluation of the patients included in our study, highlighted bone density values at the level of the anterior wall of acetabulum in women 33HU on the right and 27 HU on the left, and in men 36 HU on the right and 30 HU on the left.

Quantitative Computed Tomography (QCT) measures the mineral content of trabecular bone in the lumbar spine and provides an equivalent for calculating bone density in other segments of the body. This is done in terms of calcium hydroxyapatite mg/cm³, which allows volumetric measurement of BMD at an even lower radiation dose than a routine CT examination (10-20 mSv) [41].

The first steps in bone demineralization characterize osteopenia. This represents thinning of the bone mass and is considered a very serious risk factor for the development of osteoporosis. It is commonly found in people of both genders over 50 who have a lower than average bone density but have not yet developed osteoporosis. Basically, the difference between osteopenia and osteoporosis is the measure of bone mineral density [42].

The latter represents "brittle bone disease" and is characterized by a loss of bone mass caused by a deficiency of calcium, vitamin D, magnesium and other vitamins and minerals. as osteoporosis progresses, it can lead to decreased height, stooped posture, hunchback, and severe joint pain [43].

For the differential diagnosis between the two pathologies, the Bone Mineral Density (BMD) is used. BMD testing is performed through non-invasive and painless procedures,

usually performed on the hip, spine, wrist, finger, tibia or heel, to which all patients in the study group underwent [44].

Osteopenia can be diagnosed using just plain X-rays, while the most common method of measuring BMD (and one way to definitively diagnose osteoporosis) is by dual-energy X-ray absorptiometry, or DEXA. The low-energy X-ray scanning procedure exposes patients to much less radiation than standard X-rays and can assess bone calcium levels. The scoring through this maneuver is done by comparing the results with those of healthy individuals, aged 30, of the same sex and race - the T score. making the difference between the "normally young" score and the patient's score, we find the so-called standard deviation (SD). Patients with T-scores as low as -1 SD can still be considered healthy (see table below), those with T-scores between -1 SD and -2.5 SD are diagnosed with osteopenia and are considered at high risk of osteoporosis, while patients with T scores lower than -2.5 SD are diagnosed with osteoporosis. The latter require treatment that combines the use of drugs to help increase bone mass, as well as lifestyle changes such as diet and exercise [45].

It has been demonstrated that clinical contrast-enhanced CT enterography (CTE) examinations provide synchronous hip BMD, T-scores, and also clinical classifications that are comparable to those obtained from DXA [44]. In situations when it is combined with BCT analysis, CTE is capable to identify a category of patients with osteopenia and clinically relevant low levels of femoral strength. This places these patients at high risk of hip fracture [47].

Disadvantages of this procedure include the fact that it may involve the need for phantoms and post-processing procedures, and T-scores should not be used to define osteoporosis with QCT [48, 49].

The World Health Organization

recommends DXA screening for BMD measurement in patients over 50 years of age, and this has led to the opportunistic use of CT imaging for qualitative and quantitative bone determinations using HU [50-52].

A recent study carried out on patients from different age groups shows especially the HU values at the level of the anterior acetabular segment to be low in elderly patients, most of them osteoporotic. The average values of the density of the anterior wall of the acetabulum were identified as 26 HU and 37 HU, respectively, in women and men from the category of elderly patients, and in the young and healthy population, values of 118 HU in women and 134 HU in men were detected [53]. We measured the same values and the results were highly similar to those obtained in the reference studies.

From our study, it is certain that all investigated patients have high blood pressure (HBP), in different stages. All patients in the study group present at least one other pathology associated with BPH. It has been recently proved that inflammatory and/or immune response during high blood pressure, together with increased sympathetic outflow, cytokines, angiotensin II, oxidative stress and CVD can affect bone metabolism [54]. Most of these observational studies were recently performed in general population or within specific regional ones [55-57].

Although blood removal makes biopsy of MSCs more feasible, a better understanding of their biological nature, morphological and functional properties is needed before they can be applied in medical settings. Future research is needed to examine these different identified cell populations, to fully characterize both, as well as their respective physiological roles, behaviors and interactions. Once this is achieved, MSCs and COPs will be able to provide a baseline for future research on the role of these cells in pathology and provide consistency among researchers regarding the

precise identity of the populations studied.

Recent discoveries allow a more accurate understanding of blood fractions and vascular niches in bone, respectively to convey their importance in the regulation of bone development and physiology. The contribution of blood vessels and its different cellular fractions in bone functions and remodeling has recently gained enormous interest due to their therapeutic potential. The skeletal system performs multiple functions in the body to regulate growth, homeostasis, and metabolism, and blood vessels provide support for the various cell types in bone and maintain functional niches in the bone marrow microenvironment. The heterogeneity inside the blood vessels and vascular niches indicates the importance of the latter specialized in the regulation of bone functions, with direct applicability in the biomechanics of the hip joint.

From these considerations, angiogenesis plays a significant role in regulating bone development and directly influences the processes of osteogenesis [58, 59] and chondrogenesis [59, 61, 62]. Recent studies point to a unique, germ-like way of growing blood vessels in bone. This type of germinal angiogenesis involves endothelial "tip cells" at the front of the new vessel buds, which display long extensions or filopodia. These extensions are oriented towards the angiogenic factors of endothelial proliferation. At their base, "stalk cells" follow and proliferate to elongate the germ [63-65].

The phenomena that compete with the growth of blood vessels are basically a response to tissue oxygen demand or hypoxic conditions. Under hypoxic conditions, osteoblasts accumulate HIFs, leading to increased expression of vascular proliferation factors and other angiogenic genes [61-65]. Thus, higher levels of HIF-1 α were detected in H-type endothelium compared to L-type. At the same time, additional stabilization of HIFs

in bone increased the number of H-type capillaries in bone [59], using the Hippo signaling pathway to regulate the endothelial response to hypoxia in bone [66]. The unique nature of bone vasculature and its angiogenesis presents specific regional characters and confers the need to understand the growth of blood vessels specific to each tissue. The involvement of bone in the regulation of whole-body homeostasis indicates that systemic drug targeting of blood vessels has an impact on bone vasculature that is not yet known.

Basically, arteries enter the bone and branch into smaller and smaller arterioles to end in specialized H-type capillaries. These latter are connected to L-type capillaries, which drain the blood into smaller veins and then into a larger vein. H-type capillaries, also called endosteal capillaries or transition zones, are located in the regions of the metaphysis and endosteum, while L-type capillaries form dense, fenestrated and highly branched sinusoidal network structures in the marrow cavity [59, 61].

Among other associated pathologies, the most common were diabetes mellitus type II (36/66.66%), insulin-requiring or not, obesity (28/51.85%), chronic kidney disease (28/51.85) and endocrine pathology (6/11.11%). All of these are known to increase bone turnover and imbalances in bone metabolism. The pathological changes are taking place by affecting levels of T lymphocyte, B lymphocyte, monocytes, and cytokines [67]. High blood sugar may slow down bone formation, just as with steroids [67, 69]

From the results highlighted in Table 2, it is evident that almost all patients present periarticular arteriosclerotic foci or at the level of the branches of origin of those arteries. Another important aspect is the fact that our study highlights a high correspondence between systemic arteriopathy (coronary

artery disease, carotid stenosis, vertebrobasilar, etc.) and the phenomena of acetabular bone demineralization and at the level of the femoral head.

Regarding this aspect, our results are also highly similar to those from most of the published works. Newly studies suggest that this association between osteoporosis and CVD, especially vascular calcifications is not simply an aging phenomenon, but could be biologically linked. In the whole set of events competing of vascular calcification, the transformation of vascular smooth muscle cells into an osteoblast-like phenotype is caused by the release of the vesicular structures and mineralization within these structures. These phenomena are considering mineral metabolism, like phosphorus, calcium or parathyroid hormone, or the expression of osteogenic factors. Also, vascular calcification seems to impact bone metabolism. This is demonstrated by the crosslink between these tissues, suggesting that inhibitors of the Wnt pathway, such as secreted frizzled Proteins 2 and 4 and Dickkopf related protein-1 (DKK-1), play a linking role between those pathologies. Thus, it seems that the control of chronic kidney disease, especially serum phosphorus, are the main target for physiological bone turnover and protection against vascular calcification [70, 71].

Within our study group, all investigated situations of low bone density, measured at the level of the femoral head, correlate with low acetabular density. At the same time, cases with the lower bone density of the femoral head, were correlated with arteriosclerosis in different other regions of the body.

The supply of vascularization is fundamental for the formation of bone and the maintenance of homeostasis of its tissue. To date, no direct molecular relationship between angiogenesis and the etiopathogenesis of bone disease or age-related factors has been

identified in human subjects. Osteopenia is an impairment of BMD that is low and is a sign of normal aging. Recent studies show that type H blood vessels have recently been identified as strongly positive for CD31 and Endomucin marker in mice, representing an important indicator of aging and osteopenia in human subjects [72]. Age-dependent BMD losses of H-type vessels, in the case of elderly subjects, mirror their abundance and osteoprogenitors, in the case of the young population. These observations may be relevant for changes in the skeletal microarchitecture, in the condition of advanced osteopenia. In these studies, ovariectomized mice showed significantly reduced H-vessels accompanied by reduced osteoprogenitors, concomitant with impaired bone microarchitecture and osteoporosis, suggesting that this feature is an indicator of bone mass independent of aging [73]. Administration of deferioxamine resulted in significant increase in bone mass through enhanced angiogenesis and proliferation of H-

type vessels in ovariectomized mice. Human H-type blood vessels represent an early marker of bone loss and a potential target for improving bone quality by inducing bone growth [74].

The dentist must have evidence of the pathology associated with the patient and its medication. The risks in dental practice are major in the case of patients with anticoagulant medication or pacemakers and who do not declare this.

At the same time, the dentist must also evaluate the osteopathic risk of the patient through the anamnesis and family history.

The fact that the two categories of pathologies can coexist exponentially increases the risk of surgical interventions in the dental sphere and this must be evaluated accurately.

Table 1. Associated pathology

Associated pathology	Number of Patients
High Blood Pressure	54/100%
Arteriosclerosis and Cardiac Ischemia	38/70.37%
Cardiomyopathy orValvulopathies	44/81.48%
Stroke	16/29,62%
Other Pathologies	54/100%

Table 2.Types of arteriosclerosis

Arteriosclerosis	Number of Patients
Femoral Circumflex Arteries	52/96.29%
Femoral Arteries	20/37.03%
External and Common Iliac Arteries	12/22.22%
Abdominal aorta	6/11.11%
Others	42/77.77%

CONCLUSIONS

1. The bone density of the femoral head, measured by this direct method, can give important information about the existence of a degree of bone demineralization. The direct measurement of the acetabular density, as cancellous bone, still requires extensive, cohort studies in order to be edified as a study method.
2. Corroborating the two CT techniques for measuring bone density, with the highlighting of the periarticular vascular system through the injection of a contrast substance, brings measurable and certain data on the state of health of the entire cardiovascular system.
3. It is necessary to continue this research in order to be able to come up with accurate data on clinical, paraclinical, laboratory and radiological correlations with a staging and prognostic character both in diseases of the cardiovascular system and in osteoporotic disease.
4. Dental practitioner must take into account the possibility that two entities with great potential risk for health and oral treatments can coexist in different non-diagnostic forms and amplify these problems.

Conflicts of Interest: The authors declare no conflicts of interest.

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