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Qualitative analysis of bone and association with future fracture risk in chronic kidney disease patients

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Objectives: This study was designed to evaluate bone quality in predialytic chronic kidney disease (CKD) patients compared with healthy control using dual energy X-ray absorptiometry (DXA) and analyze the correlations between the DXA parameters and the fracture risk in both group.

Methods: This retrospective study included 64 CKD patients (median 69 years; M : F, 33 : 31) and 91 healthy control (median 69 years, M : F, 43 : 38). The bone quality values were trabecular bone score (TBS) of lumbar spine (LS) and hip geometric parameters (hip axis length, strength index, section modulus, cross-sectional area [CSA] and cross-sectional moment of inertia [CSMI]) extracted from DXA images in addition to bone mineral density (BMD). The risks of major osteoporotic fracture (MOF) and hip fracture (HF) were assessed by Fracture Risk Assessment Tool (FRAX). The association between DXA parameters and FRAX results were analyzed with all subset-regression.

Results: As for LS, although BMD was not significantly different between two groups, TBS was significantly lower in CKD patients than control in both genders. Female CKD patients showed significant lower value of femur neck BMD, the section modulus and CSA. The male patient did not show significant difference in femur parameters. In female, the TBS adjusted probabilities of MOF (median, 9.100; interquartile ratio [IQR], 5.750 - 10.000; vs. 6.400; IQR, 4.750 - 8.400; $P = 0.010$) and HF (median, 2.800; IQR, 1.050 - 4.000; vs. 1.500; IQR, 0.600 - 2.800; $P = 0.027$) were significantly higher in CKD patients. In addition, section modulus, CSA and CSMI had the significant correlation with all FRAX results.

Conclusions: The female CKD patients could be more susceptible for the osteoporotic fracture compared with control despite similar bone quantity. The prediction of future risk of fracture may be possible through a qualitative analysis of the bones especially in CKD patients.

Table1

Table 1. The difference in DXA results of enrolled participants

Characteristics	Male			Female		
	CKD (N=33)	Control (N=43)	*P* - value	CKD (N=31)	Control (N=48)	*P* - values
TBS	1.326 ± 0.109	1.409 ± 0.076	<0.001	1.264 ± 0.087	1.347 ± 0.080	<0.001
FN BMD	0.861 ± 0.167	0.907 ± 0.146	0.207	0.750 ± 0.115	0.805 ± 0.095	0.023
LS BMD	1.269 ± 0.268	1.258 ± 0.222	0.846	1.045 ± 0.167	1.036 ± 0.162	0.811
HAL	112.791 ± 6.973	114.547 ± 6.538	0.263	99.190 ± 4.966	101.533 ± 5.326	0.054
Strength Index	1.500 [1.300;1.700]	1.500 [1.300;1.850]	0.929	1.400 [1.200;1.600]	1.400 [1.150;1.700]	0.746
Section Modulus	624.100 [542.500;895.100]	708.200 [644.100;789.450]	0.332	446.597 ± 80.541	491.117 ± 90.917	0.029
CSMI	11489.000 [10059.000;16313.000]	12438.000 [11750.000;14831.500]	0.337	7158.000 [6087.500;8557.500]	7578.500 [6696.000;8833.500]	0.228
CSA	144.970 ± 31.647	153.535 ± 28.779	0.222	112.935 ± 19.784	121.417 ± 17.126	0.047

DXA, dual energy X-ray absorptiometry; CKD, chronic kidney disease; TBS, trabecular bone score; FN BMD, femoral neck bone mineral density; LS BMD, lumbar spine bone mineral density; HAL, hip axis length; cross-sectional moment inertia; CSA, cross-sectional area