

Supplementary Materials: Association between Uremic Toxin Concentrations and Bone Mineral Density after Kidney Transplantation

Benjamin Batteux Sandra Bodeau, Camille André, Anne-Sophie Hurtel-Lemaire, Valérie Gras-Champel, Isabelle Desailly-Henry, Kamel Masmoudi, Youssef Bennis, Ziad A. Massy, Saïd Kamel, Gabriel Choukroun and Sophie Liabeuf

Table S1. Statistical significance (p value) of Spearman's correlation coefficients for UT concentrations upon transplantation.

UT Concentrations	pCS	CMPF	IxS	pCG	HA	TMAO	IAA
pCS		0.0530	0.0330	<0.0001	0.0005	0.0133	<0.0001
CMPF	0.0530		0.0017	0.0433	0.0009	0.0016	0.0102
IxS	0.0330	0.0017		<0.0001	<0.0001	<0.0001	0.0338
pCG	<0.0001	0.0433	<0.0001			<0.0001	<0.0001
HA	0.0005	0.0009	<0.0001	<0.0001		<0.0001	<0.0001
TMAO	0.0133	0.0016	<0.0001	<0.0001	<0.0001		<0.0001
IAA	<0.0001	0.0102	0.0338	<0.0001	<0.0001	<0.0001	

CMPF, 3-carboxy-4-methyl-5-propyl-furanpropionic acid; HA, hippuric acid; IAA, indole-3-acetic acid; IxS, indoxylsulfate; pCG, p-cresylglucuronide; pCS, p-cresylsulfate; TMAO, trimethylamine-N-oxide; UT, uremic toxin.

Table S2. Changes in BMD at M12 and M24, by subgroup.

Time after Transplantation	Lumbar Spine			Femoral Neck			Total Hip		
	BMD Change (g/cm ²), m ± SD	BMD Change (%), m ± SD	p value	BMD Change (g/cm ²), m ± SD	BMD Change (%), m ± SD	p value	BMD Change (g/cm ²), m ± SD	BMD Change (%), m ± SD	P value
12 months after transplantation									
All, n = 310	-0.001 ± 0.063	-0.2 ± 6.3	0.793	-0.008 ± 0.054	-0.9 ± 7.3	0.034	-0.025 ± 0.051	-2.7 ± 5.8	< 0.001
Female, n = 116	+0.000 ± 0.055	+0.4 ± 5.8	0.996	-0.016 ± 0.058	-2.3 ± 8.2	0.068	-0.015 ± 0.051	-1.7 ± 6.4	0.005
< 50, n = 59	+0.006 ± 0.049	+1.0 ± 5.1	0.360	+0.007 ± 0.056	+0.9 ± 4.6	0.551	-0.002 ± 0.039	-0.2 ± 4.6	0.728
> 50, n = 57	-0.006 ± 0.061	-0.3 ± 6.5	0.450	-0.038 ± 0.051	-5.4 ± 7.6	0.001	-0.027 ± 0.059	-3.2 ± 7.5	0.002
Male, n = 194	-0.002 ± 0.068	-0.2 ± 6.5	0.754	-0.005 ± 0.052	-0.2 ± 6.7	0.359	-0.031 ± 0.050	-3.2 ± 5.4	< 0.001
< 50, n = 79	+0.005 ± 0.066	+1.0 ± 6.7	0.544	-0.006 ± 0.054	-0.3 ± 7.0	0.512	-0.030 ± 0.056	-3.0 ± 6.0	< 0.001
> 50, n = 115	-0.006 ± 0.068	-0.4 ± 6.3	0.377	-0.004 ± 0.052	-0.2 ± 6.6	0.525	-0.031 ± 0.045	-3.3 ± 5.0	< 0.001
ABD, n = 39	-0.014 ± 0.062	-0.9 ± 5.9	0.283	-0.025 ± 0.044	-3.3 ± 5.5	0.027	-0.048 ± 0.053	-4.9 ± 5.5	< 0.001
No ABD, n = 271	+0.000 ± 0.063	+0.4 ± 6.3	0.905	-0.006 ± 0.55	-0.6 ± 7.4	0.224	-0.022 ± 0.050	-2.4 ± 5.8	< 0.001
ESW, n = 41	+0.031 ± 0.066	+3.6 ± 6.6	0.006	+0.001 ± 0.056	+0.6 ± 8.1	0.909	-0.021 ± 0.061	-2.0 ± 6.7	0.047

OSR, n = 269	-0.006 ± 0.061	-0.2 ± 6.1	0.142	-0.011 ± 0.054	-1.2 ± 7.1	0.035	-0.026 ± 0.049	-2.8 ± 5.6	< 0.001
24 months after transplantation									
All, n = 222	-0.020 ± 0.066	-1.6 ± 6.4	< 0.001	-0.009 ± 0.059	-0.9 ± 7.7	0.045	-0.011 ± 0.062	-1.0 ± 6.9	0.017
Female, n = 86	-0.022 ± 0.061	-1.9 ± 6.2	0.001	-0.009 ± 0.064	-0.8 ± 8.9	0.407	-0.002 ± 0.057	-0.0 ± 7.0	0.756
< 50, n = 46	-0.018 ± 0.057	-1.6 ± 5.7	0.036	-0.013 ± 0.056	-1.7 ± 7.0	0.276	+0.006 ± 0.057	+0.9 ± 6.5	0.498
> 50, n = 40	-0.026 ± 0.066	-2.2 ± 6.7	0.015	-0.002 ± 0.075	+0.5 ± 11.1	0.896	-0.011 ± 0.056	-1.0 ± 7.5	0.249
Male, n = 136	-0.018 ± 0.069	-1.4 ± 6.5	0.003	-0.009 ± 0.056	-1.0 ± 7.1	0.196	-0.016 ± 0.065	-1.5 ± 6.9	0.008
< 50, n = 60	-0.011 ± 0.074	-0.4 ± 6.5	0.273	-0.004 ± 0.060	-0.1 ± 7.2	0.689	-0.007 ± 0.064	-0.3 ± 6.3	0.410
> 50, n = 76	-0.024 ± 0.065	-2.2 ± 6.5	0.002	-0.012 ± 0.054	-1.8 ± 7.0	0.167	-0.022 ± 0.065	-2.5 ± 7.2	0.005
ABD, n = 26	-0.039 ± 0.093	-3.0 ± 7.5	0.044	-0.012 ± 0.059	-2.1 ± 6.2	0.411	-0.034 ± 0.078	-3.2 ± 7.1	0.057
No ABD, n = 196	-0.017 ± 0.062	-1.5 ± 6.2	< 0.001	-0.008 ± 0.059	-0.7 ± 8.0	0.192	-0.008 ± 0.060	-0.7 ± 6.9	0.080
ESW, n = 16	+0.036 ± 0.059	+3.9 ± 5.8	0.028	+0.007 ± 0.064	+1.1 ± 9.5	0.702	+0.015 ± 0.056	+2.1 ± 7.0	0.275
OSR, n = 206	-0.024 ± 0.065	-2.0 ± 6.2	< 0.001	-0.010 ± 0.058	-1.2 ± 7.5	0.075	-0.013 ± 0.062	-1.2 ± 6.9	0.005

ABD, adynamic bone disease; BMD, bone mineral.

Table S3. Correlations between BMD at M1 and quantitative variables.

Quantitative Variables	Lumbar Spine BMD		Femoral Neck BMD		Total Hip BMD	
	ρ	p value	ρ	p value	ρ	p value
Recipient's age	+0.11	0.050	-0.12	0.078	-0.03	0.564
BMI	+0.31	<0.001	+0.27	<0.001	+0.42	<0.001
Laboratory data (M0)						
Serum calcium	-0.12	0.036	-0.06	0.403	-0.06	0.314
Serum phosphate	-0.04	0.451	-0.05	0.462	+0.02	0.679
Serum 25 (OH) vitamin D3	-0.04	0.463	-0.02	0.754	-0.04	0.485
Serum PTH	-0.17	0.003	-0.09	0.178	-0.13	0.040
Serum bone alkaline phosphatases	-0.05	0.453	-0.01	0.846	-0.04	0.557
Serum osteocalcin	-0.09	0.240	+0.06	0.456	-0.00	0.999

BMI, body mass index; ρ, Spearman's correlation coefficient; PTH, parathyroid hormone.

Table S4. Correlations between BMD at M1 and binary variables.

Binary Variables	Lumbar Spine			Femoral Neck			Total Hip		
	BMD		<i>p</i> value	BMD		<i>p</i> value	BMD		<i>p</i> value
	No	Yes		No	Yes		No	Yes	
Female	1.034 ± 0.16	0.970 ± 0.16	<0.001	0.788 ± 0.16	0.693 ± 0.12	<0.001	0.929 ± 0.15	0.822 ± 0.13	<0.001
Ethnic group (Caucasian)	1.035 ± 0.16	1.008 ± 0.16	0.492	0.831 ± 0.22	0.751 ± 0.15	0.138	0.914 ± 0.13	0.890 ± 0.15	0.555
Thyroid disorders	1.009 ± 0.16	1.022 ± 0.17	0.750	0.758 ± 0.15	0.691 ± 0.10	0.122	0.893 ± 0.15	0.863 ± 0.15	0.454
Prior osteoporotic fractures	1.016 ± 0.16	1.004 ± 0.17	0.826	0.759 ± 0.15	0.705 ± 0.16	0.111	0.894 ± 0.15	0.860 ± 0.16	0.274
Diabetes mellitus	0.999 ± 0.16	1.065 ± 0.16	0.008	0.752 ± 0.15	0.766 ± 0.15	0.614	0.892 ± 0.15	0.885 ± 0.14	0.764
Chronic inflammatory rheumatism	1.011 ± 0.16	0.943 ± 0.16	0.402	0.755 ± 0.15	0.635 ± 0.09	0.262	0.893 ± 0.15	0.759 ± 0.09	0.079
Autoimmune diseases	1.014 ± 0.16	0.956 ± 0.16	0.121	0.756 ± 0.15	0.725 ± 0.17	0.482	0.894 ± 0.15	0.850 ± 0.17	0.247
Primary HPT	1.007 ± 0.16	1.130 ± 0.15	0.033	0.752 ± 0.15	0.815 ± 0.13	0.314	0.890 ± 0.15	0.932 ± 0.11	0.434
Secondary HPT	1.037 ± 0.16	1.005 ± 0.16	0.227	0.755 ± 0.14	0.754 ± 0.15	0.976	0.909 ± 0.15	0.888 ± 0.15	0.423
Smoking	1.003 ± 0.15	1.017 ± 0.17	0.461	0.745 ± 0.15	0.763 ± 0.15	0.382	0.882 ± 0.16	0.901 ± 0.15	0.284
Alcohol consumption	1.010 ± 0.16	1.015 ± 0.18	0.877	0.755 ± 0.15	0.732 ± 0.14	0.560	0.892 ± 0.15	0.877 ± 0.14	0.678
Prior steroid intake	1.024 ± 0.16	0.944 ± 0.15	<0.001	0.758 ± 0.14	0.732 ± 0.18	0.320	0.899 ± 0.14	0.852 ± 0.18	0.048
Prior calcium intake	0.999 ± 0.16	1.039 ± 0.17	0.052	0.746 ± 0.15	0.780 ± 0.16	0.155	0.885 ± 0.14	0.909 ± 0.7	0.234
Prior vitamin D intake	1.013 ± 0.15	1.007 ± 0.17	0.744	0.750 ± 0.13	0.758 ± 0.17	0.684	0.891 ± 0.14	0.891 ± 0.17	0.982
Prior BP intake	1.011 ± 0.16	0.864 ± 0.04	0.199	0.754 ± 0.15	0.750 ± 0.10	0.980	0.892 ± 0.15	0.810 ± 0.00	0.447

BP, bisphosphonate; HPT, hyperparathyroidism; MMF, mycophenolate mofetil;

Table S5. Correlations between changes in BMD at M12 and quantitative variables.

Quantitative Variables	Lumbar Spine BMD		Femoral Neck BMD		Total Hip BMD	
	ρ	<i>p</i> value	ρ	<i>p</i> value	ρ	<i>p</i> value
Recipient age	-0.11	0.057	-0.10	0.225	-0.16	0.006
BMI	-0.11	0.064	+0.20	0.015	-0.02	0.706
Laboratory data						
Serum calcium	-0.01	0.892	+0.01	0.952	-0.11	0.074
Serum phosphate	+0.07	0.233	-0.03	0.703	-0.09	0.142
Serum 25 (OH) vitamin D3	-0.10	0.079	+0.03	0.759	-0.01	0.823
Serum PTH	+0.06	0.263	+0.20	0.019	+0.19	0.002
Serum bone alkaline phosphatases	+0.01	0.849	+0.19	0.038	+0.26	<0.001
Serum osteocalcin	+0.07	0.331	+0.14	0.175	+0.20	0.009
Serum creatinine at M12	-0.06	0.263	-0.09	0.258	+0.04	0.482

BMI, body mass index; ρ , Spearman's correlation coefficient; PTH, parathyroid hormone.

Table S6. Correlations between changes in BMD at M12 and binary variables.

Binary Variables	Lumbar Spine			Femoral Neck			Total Hip		
	BMD Variations		<i>p</i> value	BMD Variations		<i>p</i> value	BMD Variations		<i>p</i> value
	No	Yes		No	Yes		No	Yes	
Female	-0.002 ± 0.06	+0.000 ± 0.07	0.834	-0.005 ± 0.06	-0.016 ± 0.016	0.262	-0.015 ± 0.05	-0.031 ± 0.05	0.012
Race (Caucasian)	-0.002 ± 0.04	-0.001 ± 0.06	0.966	-0.002 ± 0.07	-0.009 ± 0.05	0.752	-0.001 ± 0.03	-0.026 ± 0.05	0.060
Thyroid disorders	-0.000 ± 0.06	+0.003 ± 0.04	0.327	-0.007 ± 0.05	-0.027 ± 0.06	0.309	-0.024 ± 0.05	-0.048 ± 0.04	0.086
Prior osteoporotic fractures	-0.00 ± 0.06	-0.009 ± 0.07	0.453	-0.009 ± 0.05	-0.005 ± 0.05	0.819	-0.025 ± 0.05	-0.023 ± 0.07	0.805
Diabetes mellitus	+0.001 ± 0.06	-0.008 ± 0.06	0.363	-0.010 ± 0.05	-0.005 ± 0.06	0.739	-0.025 ± 0.05	-0.026 ± 0.06	0.924
Chronic inflammatory rheumatism	-0.001 ± 0.06	+0.024 ± 0.06	0.431	-0.008 ± 0.05	-0.014 ± 0.01	0.893	-0.025 ± 0.05	-0.010 ± 0.03	0.552
Autoimmune diseases	-0.003 ± 0.06	+0.025 ± 0.06	0.054	-0.007 ± 0.05	-0.028 ± 0.08	0.229	-0.026 ± 0.05	-0.015 ± 0.04	0.383
Primary HPT	+0.001 ± 0.06	-0.077 ± 0.10	0.001	-0.006 ± 0.05	-0.117 ± 0.06	<0.001	-0.024 ± 0.05	-0.052 ± 0.06	0.155
Secondary HPT	-0.015 ± 0.07	+0.001 ± 0.06	0.105	-0.041 ± 0.06	-0.004 ± 0.05	0.005	-0.035 ± 0.05	-0.023 ± 0.05	0.182
Smoking	+0.000 ± 0.06	-0.002 ± 0.06	0.716	-0.002 ± 0.05	-0.015 ± 0.06	0.172	-0.024 ± 0.05	-0.026 ± 0.05	0.721
Alcohol consumption	-0.001 ± 0.06	-0.007 ± 0.06	0.649	-0.011 ± 0.06	-0.012 ± 0.04	0.852	-0.024 ± 0.05	-0.040 ± 0.05	0.175
Calcium intake during the study period	+0.005 ± 0.06	-0.012 ± 0.07	0.024	-0.010 ± 0.05	-0.005 ± 0.05	0.657	-0.026 ± 0.05	-0.024 ± 0.05	0.737
Vitamin D intake during the study period	-0.001 ± 0.07	-0.001 ± 0.06	0.966	+0.011 ± 0.06	-0.012 ± 0.05	0.074	-0.009 ± 0.06	-0.025 ± 0.05	0.113
BP intake during the study period	-0.003 ± 0.06	+0.054 ± 0.05	0.003	-0.008 ± 0.05	-0.036 ± 0.01	0.470	-0.025 ± 0.05	-0.028 ± 0.05	0.852
Induction therapy									
Basiliximab	-0.007 ± 0.07	+0.005 ± 0.06	0.107	-0.009 ± 0.05	-0.008 ± 0.06	0.961	-0.033 ± 0.05	-0.018 ± 0.05	0.014
Thymoglobulin	+0.004 ± 0.06	-0.007 ± 0.07	0.134	-0.008 ± 0.06	-0.009 ± 0.05	0.961	-0.019 ± 0.05	-0.032 ± 0.05	0.040
Intravenous immunoglobulins	-0.002 ± 0.06	+0.019 ± 0.08	0.241	-0.008 ± 0.05	-0.011 ± 0.04	0.879	-0.026 ± 0.05	-0.009 0.05	0.291
Maintenance therapy									

MMF + tacrolimus	-0.013 ± 0.06	+0.003 ± 0.06	0.064	+0.003 ± 0.06	-0.012 ± 0.05	0.178	-0.035 ± 0.05	-0.022 ± 0.05	0.062
MMF + cyclosporine	+0.006 ± 0.06	-0.014 ± 0.06	0.010	-0.012 ± 0.05	+0.001 ± 0.05	0.222	-0.022 ± 0.05	-0.031 ± 0.05	0.182
Tacrolimus + everolimus	+0.000 ± 0.06	-0.011 ± 0.07	0.377	-0.008 ± 0.05	-0.015 ± 0.05	0.704	-0.025 ± 0.05	-0.025 ± 0.05	0.994
MMF + everolimus	-0.001 ± 0.06	-0.003 ± 0.06	0.836	-0.006 ± 0.06	-0.022 ± 0.04	0.246	-0.023 ± 0.05	-0.037 ± 0.05	0.095
Tacrolimus + azathioprine	-0.001 ± 0.06	+0.004 ± 0.770	0.770	-0.008 ± 0.05	-0.028 ± 0.01	0.476	-0.026 ± 0.05	-0.008 ± 0.04	0.206
Early steroid withdrawal	-0.006 ± 0.06	+0.031 ± 0.07	<0.001	-0.010 ± 0.05	+0.001 ± 0.06	0.318	-0.026 ± 0.05	-0.021 ± 0.06	0.583

BP, bisphosphonate; HPT, hyperparathyroidism; MMF, mycophenolate mofetil.

Table S7. Correlations between changes in BMD at M24 and quantitative variables.

Quantitative Variables	Lumbar spine		Femoral neck		Total hip	
	Correlation coefficient	<i>P</i> value	Correlation coefficient	<i>P</i> value	Correlation coefficient	<i>P</i> value
Recipient age	-0.07	0.311	-0.08	0.397	-0.19	0.006
BMI	+0.00	0.973	+0.09	0.326	-0.06	0.398
Laboratory data						
Serum calcium	+0.09	0.172	+0.06	0.551	-0.03	0.658
Serum phosphate	+0.14	0.033	+0.24	0.011	+0.01	0.856
Serum 25 (OH) vitamin D3	-0.08	0.246	+0.06	0.563	+0.00	0.987
Serum PTH	+0.07	0.302	+0.28	0.003	+0.19	0.006
Serum bone alkaline phosphatases	+0.01	0.866	+0.08	0.449	+0.22	0.005
Serum osteocalcin	+0.14	0.099	+0.28	0.017	+0.19	0.061
Serum creatinine at M12	-0.13	0.048	-0.28	0.003	-0.15	0.028

BMI, body mass index; ρ , Spearman's correlation coefficient; PTH, parathyroid hormone.

Table S8. Correlations between changes in BMD at M24 and binary variables.

Binary Variables	Lumbar Spine			Femoral Neck			Total Hip		
	BMD Variations		<i>p</i> value	BMD Variations		<i>p</i> value	BMD Variations		<i>p</i> value
	No	Yes		No	Yes		No	Yes	
Female	-0.018 ± 0.06	-0.022 ± 0.06	0.662	-0.009 ± 0.06	-0.009 ± 0.06	0.992	-0.002 ± 0.06	-0.016 ± 0.06	0.140
Race (Caucasian)	-0.024 ± 0.07	-0.019 ± 0.07	0.774	-0.017 ± 0.03	-0.008 ± 0.06	0.721	-0.001 ± 0.04	-0.011 ± 0.06	0.602
Thyroid disorders	-0.019 ± 0.07	-0.020 ± 0.04	0.977	-0.007 ± 0.06	-0.039 ± 0.05	0.236	-0.010 ± 0.06	-0.023 ± 0.03	0.483
Prior osteoporotic fractures	-0.021 ± 0.07	-0.003 ± 0.06	0.236	-0.009 ± 0.05	-0.009 ± 0.09	0.786	-0.012 ± 0.06	+0.001 ± 0.06	0.401
Diabetes mellitus	-0.018 ± 0.07	-0.027 ± 0.07	0.480	-0.005 ± 0.06	-0.041 ± 0.05	0.052	-0.009 ± 0.06	-0.019 ± 0.06	0.490
Chronic inflammatory rheumatism	-0.021 ± 0.07	+0.022 ± 0.06	0.203	-0.008 ± 0.06	-0.019 ± 0.03	0.802	-0.011 ± 0.06	-0.011 ± 0.02	0.984
Autoimmune diseases	-0.022 ± 0.07	+0.015 ± 0.06	0.031	-0.009 ± 0.06	-0.005 ± 0.09	0.869	-0.012 ± 0.06	+0.013 ± 0.06	0.134
Primary HPT	-0.017 ± 0.06	-0.098 ± 0.010	0.003	-0.008 ± 0.06	-0.021 ± 0.09	0.664	-0.010 ± 0.06	-0.032 ± 0.05	0.391
Secondary HPT	-0.029 ± 0.08	-0.018 ± 0.06	0.331	-0.029 ± 0.06	-0.005 ± 0.06	0.131	-0.016 ± 0.06	-0.010 ± 0.06	0.602
Smoking	-0.020 ± 0.07	-0.019 ± 0.06	0.894	-0.012 ± 0.05	-0.005 ± 0.07	0.562	-0.011 ± 0.07	-0.010 ± 0.05	0.859
Alcohol consumption	-0.019 ± 0.07	-0.020 ± 0.05	0.964	-0.009 ± 0.06	+0.008 ± 0.05	0.495	-0.010 ± 0.06	-0.020 ± 0.07	0.613
Prior steroid intake	-0.021 ± 0.06	-0.013 ± 0.08	0.523	-0.009 ± 0.06	-0.008 ± 0.05	0.950	-0.013 ± 0.016	+0.002 ± 0.07	0.173
Calcium intake during the study period	-0.015 ± 0.06	-0.027 ± 0.08	0.197	-0.005 ± 0.06	-0.015 ± 0.06	0.388	-0.010 ± 0.06	-0.012 ± 0.06	0.782

Vitamin D intake during the study period	-0.017 ± 0.06	-0.020 ± 0.07	0.854	-0.019 ± 0.06	-0.007 ± 0.06	0.442	+0.009 ± 0.05	-0.014 ± 0.06	0.089
BP intake during the study period	-0.023 ± 0.07	+0.053 ± 0.03	<0.001	-0.010 ± 0.06	+0.043 ± 0.10	0.076	-0.011 ± 0.06	-0.003 ± 0.05	0.715
Induction therapy									
Basiliximab	-0.024 ± 0.07	-0.015 ± 0.06	0.300	-0.002 ± 0.05	-0.013 ± 0.06	0.331	-0.010 ± 0.05	-0.011 ± 0.07	0.924
Thymoglobulin	-0.015 ± 0.06	-0.024 ± 0.07	0.289	-0.013 ± 0.06	-0.002 ± 0.05	0.331	-0.012 ± 0.07	-0.010 ± 0.06	0.795
Intravenous immunoglobulins	-0.020 ± 0.07	-0.012 ± 0.04	0.783	-0.008 ± 0.06	-0.049 ± 0.02	0.330	-0.010 ± 0.06	-0.021 ± 0.05	0.664
Maintenance therapy									
MMF + tacrolimus	-0.022 ± 0.05	-0.017 ± 0.07	0.748	-0.006 ± 0.05	-0.010 ± 0.06	0.742	-0.021 ± 0.06	-0.007 ± 0.06	0.148
MMF + cyclosporine	-0.015 ± 0.07	-0.027 ± 0.06	0.210	-0.009 ± 0.06	-0.008 ± 0.05	0.960	-0.006 ± 0.06	-0.018 ± 0.06	0.193
Tacrolimus + everolimus	-0.020 ± 0.07	-0.020 ± 0.05	1.000	-0.009 ± 0.06	-0.006 ± 0.05	0.871	-0.009 ± 0.06	-0.024 ± 0.07	0.315
MMF + everolimus	-0.020 ± 0.07	-0.020 ± 0.0	0.951	-0.012 ± 0.06	+0.008 ± 0.04	0.154	-0.010 ± 0.06	-0.014 ± 0.06	0.715
Tacrolimus + azathioprine	-0.021 ± 0.07	-0.002 ± 0.06	0.347	-0.009 ± 0.06	-0.008 ± 0.03	0.976	-0.012 ± 0.06	-0.007 ± 0.04	0.301
Early steroid withdrawal	-0.024 ± 0.06	+0.036 ± 0.06	<0.001	-0.010 ± 0.06	+0.007 ± 0.06	0.328	-0.013 ± 0.06	+0.016 ± 0.06	0.077

BP, bisphosphonate; HPT, hyperparathyroidism; MMF, mycophenolate mofetil;.

Table S9. Predictive factors for a BMD decrease at M1 (multiple linear regression model).

BMD at M1	Coefficient	T value	P value
Lumbar spine			
IxS	$+5.555 \times 10^{-4}$	+1.167	0.245
BMI	$+5.153 \times 10^{-3}$	+4.001	<0.001
Male (ref. = female)	+0.035	+3.174	0.002
Serum calcium	-0.075	-2.774	0.006
Serum phosphate	-2.248×10^{-4}	-0.019	0.985
Serum 25 (OH) vitamin D3	-3.740×10^{-5}	-0.121	0.904
Serum PTH	-3.815×10^{-5}	-2.494	0.014
Serum bone alkaline phosphatases	7.782×10^{-5}	+0.176	0.861
Serum osteocalcin	-8.958×10^{-6}	-0.446	0.656
Femoral neck			
IxS	+0.001	+2.063	0.042
BMI	+0.005	+3.280	0.001
Male (ref. = female)	+0.038	+2.964	0.004
Serum calcium	-0.049	-1.599	0.112
Serum phosphate	-0.011	-0.714	0.477
Serum 25 (OH) vitamin D3	-3.310×10^{-4}	-0.953	0.342
Serum PTH	-2.753×10^{-5}	-1.346	0.181
Serum bone alkaline phosphatases	$+1.221 \times 10^{-4}$	+0.234	0.815
Serum osteocalcin	$+1.942 \times 10^{-5}$	+0.849	0.397
Total hip			
IxS	$+6.276 \times 10^{-4}$	+1.396	0.164
BMI	$+6.001 \times 10^{-3}$	+4.998	<0.001
Male (ref. = female)	$+4.558 \times 10^{-2}$	+4.379	<0.001
Serum calcium	-7.103×10^{-2}	-2.880	0.005
Serum phosphate	$+1.731 \times 10^{-3}$	+0.155	0.878
Serum 25 (OH) vitamin D3	-2.474×10^{-4}	-0.811	0.418
Serum PTH	-3.054×10^{-5}	-1.935	0.054
Serum bone alkaline phosphatases	$+1.853 \times 10^{-4}$	+0.391	0.697
Serum osteocalcin	$+4.547 \times 10^{-6}$	+0.251	0.802

BMI, body mass index; IxS, indoxylsulfate;.

Table S10. Correlations between UT concentrations and BMD at M1, by subgroup.

Subgroups	Uremic Toxins													
	pCS		CMPF		IxS		pCG		HA		TMAO		IAA	
	r	p value	r	p value	r	p value	r	p value	r	p value	r	p value	r	p value
	Lumbar spine													
All, n = 310	+0.02	0.782	+0.01	0.805	+0.04	0.477	-0.01	0.876	-0.06	0.300	+0.01	0.797	+0.03	0.656
Female, n = 116	-0.07	0.485	-0.08	0.417	+0.10	0.271	-0.15	0.111	-0.19	0.038	-0.03	0.744	+0.04	0.689
< 50, n = 59	-0.01	0.939	-0.01	0.956	+0.19	0.144	+0.02	0.863	-0.10	0.494	-0.04	0.752	+0.06	0.636
> 50, n = 57	-0.08	0.542	-0.22	0.095	-0.04	0.796	-0.26	0.049	-0.30	0.022	-0.04	0.744	-0.01	0.959
Male, n = 194	+0.03	0.710	+0.06	0.408	-0.04	0.565	+0.07	0.364	-0.02	0.802	+0.03	0.700	-0.01	0.937
< 50, n = 79	-0.03	0.814	+0.04	0.698	-0.04	0.758	+0.02	0.873	-0.00	0.974	+0.08	0.493	-0.18	0.107
> 50, n = 115	+0.07	0.478	+0.03	0.752	-0.02	0.803	+0.10	0.311	-0.03	0.722	-0.00	0.989	+0.03	0.750
ABD, n = 39	+0.03	0.852	-0.33	0.038	+0.31	0.055	+0.16	0.341	+0.14	0.393	-0.07	0.666	+0.08	0.608
No ABD, n = 271	60.01	0.834	+0.05	0.369	+0.01	0.877	-0.04	0.551	-0.07	0.238	+0.03	0.634	+0.02	0.799
	Femoral neck													
All, n = 310	+0.02	0.730	-0.05	0.448	+0.13	0.049	+0.03	0.701	-0.14	0.036	-0.00	0.975	-0.07	0.282
Female, n = 116	-0.12	0.275	+0.05	0.641	+0.12	0.282	-0.12	0.288	-0.15	0.180	-0.04	0.734	+0.07	0.540
< 50, n = 59	-0.03	0.838	+0.18	0.249	+0.10	0.538	-0.10	0.543	-0.17	0.268	+0.06	0.722	+0.09	0.584
> 50, n = 57	-0.23	0.165	-0.17	0.299	+0.14	0.398	-0.14	0.396	-0.13	0.442	-0.16	0.344	+0.05	0.776
Male, n = 194	+0.03	0.759	-0.12	0.155	+0.07	0.394	+0.03	0.691	-0.18	0.035	+0.02	0.811	-0.16	0.058
< 50, n = 79	-0.12	0.372	-0.18	0.177	+0.21	0.108	+0.01	0.942	-0.14	0.305	+0.10	0.463	-0.22	0.097
> 50, n = 115	+0.14	0.197	-0.06	0.585	-0.10	0.381	+0.05	0.641	-0.21	0.061	-0.04	0.719	-0.15	0.161
ABD, n = 39	+0.09	0.623	-0.32	0.075	+0.30	0.112	+0.06	0.772	+0.00	0.981	-0.27	0.146	-0.17	0.377

No ABD, n = 271	+0.01	0.893	-0.01	0.912	+0.10	0.174	+0.01	0.904	-0.16	0.026	+0.06	0.368	-0.05	0.455
Total hip BMD														
All, n = 310	-0.01	0.913	+0.03	0.592	+0.13	0.037	+0.01	0.901	-0.08	0.190	-0.00	0.942	-0.02	0.738
Female, n = 116	-0.23	0.024	+0.11	0.281	+0.18	0.068	-0.13	0.191	-0.13	0.190	-0.08	0.416	+0.09	0.388
< 50, n = 59	-0.11	0.441	+0.20	0.165	+0.16	0.261	+0.02	0.916	-0.08	0.568	-0.07	0.611	+0.13	0.369
> 50, n = 57	-0.30	0.034	-0.07	0.633	+0.15	0.298	-0.25	0.082	-0.22	0.119	-0.13	0.356	-0.04	0.797
Male, n = 194	+0.04	0.563	-0.04	0.555	+0.01	0.876	+0.07	0.355	-0.12	0.112	+0.01	0.931	-0.09	0.232
< 50, n = 79	+0.04	0.753	-0.02	0.853	+0.07	0.554	+0.03	0.776	-0.11	0.349	+0.02	0.892	-0.12	0.312
> 50, n = 115	+0.05	0.631	-0.05	0.620	-0.05	0.618	+0.10	0.319	-0.12	0.200	-0.01	0.892	-0.09	0.367
ABD, n = 39	+0.19	0.297	-0.19	0.291	+0.34	0.055	+0.25	0.165	+0.17	0.337	-0.20	0.267	-0.06	0.728
No ABD, n = 271	-0.05	0.490	+0.07	0.267	+0.09	0.162	-0.03	0.610	-0.10	0.106	+0.04	0.568	-0.01	0.830

ABD, adynamic bone disease; CMPF, 3-carboxy-4-methyl-5-propyl-furanpropionic acid; HA, hippuric acid; IAA, indole-3-acetic acid; IxS, indoxylsulfate; pCG, p-cresylglucuronide; pCS, p-cresylsulfate; r, correlation coefficient; TMAO, trimethylamine-N-oxide.

Table S11. Comparison of UT concentrations in patients with BMD loss vs. gain 12 months after kidney transplantation, by subgroup.

Subgroups	Lumbar Spine			Femoral Neck			Total Hip		
	BMD loss n = 154	BMD gain n = 156	p	BMD loss n = 89	BMD gain n = 56	p	BMD loss n = 197	BMD gain n = 79	p
pCS (µg/mL)									
All, n = 310	16.2 [0.02–65.7]	15.9 [0.3–68.1]	0.85 7	13.9 [0.1–52.5]	15.4 [0.5–65.7]	0.55 6	16.0 [0.1–68.1]	16.0 [0.6–57.3]	0.964
Female, n = 116	14.1 [0.5–57.3]	14.5 [1.8–46.8]	0.79 0	13.3 [0.6–42.8]	9.6 [0.5–30.6]	0.51 5	13.2 [0.6–48.47]	15.3 [1.9–57.3]	0.354
< 50, n = 59	11.5 [0.5–48.7]	12.2 [1.8–48.8]	0.72 7	8.4 [6.6–48.8]	9.6 [0.5–30.6]	0.48 7	11.2 [0.7–48.7]	14.6 [1.9–45.4]	0.240
> 50, n = 57	16.7 [0.6–57.3]	17.2 [3.4–46.8]	0.80 6	14.1 [0.6–33.5]	13.9 [3.4–23.8]	0.56 1	16.4 [0.6–43.8]	16.8 [6.9–57.3]	0.667

Male, n = 194	17.4 [0.02–65.7]	16.9 [0.3–68.1]	0.91 2	13.9 [0.1–52.5]	13.4 [0.6–65.7]	0.74 0	17.0 [0.1–68.1]	16.9 [0.6–55.6]	0.732
< 50, n = 79	16.7 [0.02–46.2]	18.5 [0.3–68.1]	0.43 2	17.4 [0.3–48.8]	15.5 [0.6–49.5]	0.96 7	16.4 [0.3–68.1]	19.5 [0.6–49.5]	0.489
> 50, n = 115	17.7 [0.07–65.7]	16.5 [0.3–55.6]	0.70 0	13.9 [0.1–52.5]	13.3 [3.2–65.7]	0.70 1	17.1 [0.1–54.0]	13.2 [3.2–55.6]	0.262
ABD, n = 39	16.7 [0.1–34.7]	17.6 [3.4–52.5]	0.25 4	14.6 [7.6–52.5]	13.3 [3.4–23.7]	0.33 6	14.3 [0.8–52.2]	21.5 [13.3–42.8]	0.281
No ABD, n = 271	16.0 [0.02–65.7]	15.9 [0.3–68.1]	0.90 1	13.0 [0.1–48.8]	13.4 [0.5–65.7]	0.83 8	16.4 [0.1–68.1]	15.7 [0.6–57.3]	0.848
GFR > 60 mL/min, n = 102	18.1 [0.02–50.6]	14.8 [1.01–50.8]	0.52 8	16.7 [1.1–46.2]	11.9 [0.5–32.7]	0.55 2	17.0 [1.1–50.8]	15.1 [1.9–42.8]	0.935
GFR < 60 mL/min, n = 208	18.6 [0.1–65.7]	16.1 [0.3–68.1]	0.50 4	13.5 [0.1–52.5]	13.4 [0.6–65.7]	0.76 3	15.5 [0.1–68.1]	16.1 [0.6–57.3]	0.935
CMPF (µg/mL)									
All, n = 310	3.0 [0.0–32.3]	2.0 [0.0–18.0]	0.00 5	2.9 [0.0–22.0]	2.2 [0.0–32.3]	0.07 0	2.5 [0.0–28.3]	2.4 [0.0–18.0]	0.921
Female, n = 116	2.4 [0.0–32.3]	1.9 [0.0–12.2]	0.43 7	2.2 [0.1–22.0]	1.5 [0.0–32.3]	0.09 8	1.6 [0.0–22.0]	2.4 [0.1–14.0]	0.266
< 50, n = 59	2.9 [0.0–5.2]	3.3 [0.0–12.2]	0.76 7	5.0 [0.8–22.0]	2.4 [0.0–32.3]	0.05 1	3.1 [0.0–22.0]	3.6 [0.1–14.0]	0.330
> 50, n = 57	1.9 [0.1–12.2]	1.2 [0.2–12.2]	0.15 4	2.9 [0.1–12.2]	1.1 [0.3–1.5]	0.15 2	1.3 [0.1–12.2]	1.0 [0.2–8.4]	1.000
Male, n = 194	3.1 [0.0–23.8]	2.1 [0.0–18.0]	0.00 4	3.3 [0.0–14.1]	2.4 [0.0–18.0]	0.25 4	2.7 [0.0–28.3]	2.4 [0.0–18.0]	0.603
< 50, n = 79	2.6 [0.0–19.0]	1.8 [0.0–8.6]	0.36 4	2.0 [0.0–9.7]	2.4 [0.0–7.3]	0.81 4	2.1 [0.0–19.0]	2.5 [0.0–7.3]	0.722
> 50, n = 115	4.5 [0.1–28.3]	2.6 [0.0–18.0]	0.00 4	4.4 [0.3–14.1]	2.4 [0.0–18.0]	0.21 2	3.3 [0.0–28.3]	2.4 [0.1–18.0]	0.462
ABD, n = 39	1.9 [0.0–12.2]	1.3 [0.0–7.4]	0.60 2	2.8 [0.0–12.2]	1.0 [0.0–2.7]	0.10 4	1.5 [0.0–7.4]	1.1 [0.4–5.9]	1.000
No ABD, n = 271	3.2 [0.0–32.3]	2.1 [0.0–18.0]	0.00 3	3.0 [0.0–22.0]	2.4 [0.0–32.3]	0.15 4	2.6 [0.0–28.3]	2.4 [0.0–18.0]	0.739

GFR > 60	2.6	2.8	0.56	2.9	1.4	0.07	2.6	2.5	0.872
mL/min, n = 102	[0.0–32.3]	[0.0–12.2]	0	[0.1–22.0]	[0.0–32.3]	9	[0.0–22.0]	[0.1–14.0]	
GFR < 60	3.4	1.8	0.00	3.3	2.4	0.34	2.4	2.3	0.997
mL/min, n = 208	[0.0–28.3]	[0.0–18.0]	3	[0.0–14.1]	[0.0–18.0]	5	[0.0–28.3]	[0.0–18.0]	
IxS (µg/mL)									
All, n = 310	20.4	19.6	0.40	19.3	19.9	0.86	19.8	20.7	0.476
	[1.2–101.0]	[1.8–67.2]	1	[1.8–68.6]	[1.3–54.5]	1	[1.2–67.2]	[3.7–101.0]	
Female, n = 116	16.4	16.1	0.81	15.0	18.1	0.39	14.6	18.6	0.027
	[1.2–101.0]	[3.7–34.8]	6	[2.2–34.8]	[6.8–40.8]	2	[1.2–57.7]	[3.7–101.0]	
< 50, n = 59	19.4	17.5	0.49	16.7	18.1	0.92	16.8	18.2	0.252
	[3.4–101.0]	[6.8–27.8]	9	[9.3–34.8]	[6.8–40.8]	8	[3.4–57.7]	[8.1–101.0]	
> 50, n = 57	14.2	15.0	0.74	13.4	17.3	0.68	12.6	19.9	0.164
	[1.2–49.5]	[3.7–31.1]	9	[2.2–33.3]	[9.6–30.7]	2	[1.2–33.3]	[3.7–31.1]	
Male, n = 194	21.3	20.7	0.53	23.7	20.0	0.61	21.2	22.1	0.982
	[1.3–68.6]	[1.8–67.2]	0	[1.8–68.6]	[1.3–54.5]	9	[1.3–67.2]	[3.8–54.5]	
< 50, n = 79	22.4	25.89	0.70	21.4	25.9	0.78	23.1	27.4	0.752
	[2.8–68.6]	[4.2–67.2]	2	[3.2–68.6]	[7.6–40.1]	3	[3.2–67.2]	[6.2–40.1]	
> 50, n = 115	20.6	19.8	0.26	19.8	17.5	0.41	20.6	18.4	0.697
	[1.3–55.1]	[1.8–65.4]	9	[1.8–54.6]	[1.3–54.5]	4	[1.3–65.4]	[3.8–54.5]	
ABD, n = 39	16.0	16.2	0.72	17.7	17.0	0.77	16.2	17.0	0.514
	[3.4–65.3]	[3.7–54.6]	4	[6.6–54.6]	[8.5–38.2]	5	[3.4–56.3]	[3.7–34.8]	
No ABD, n = 271	20.6	19.9	0.39	19.6	20.0	0.79	20.0	21.2	0.439
	[1.2–101.0]	[1.8–67.2]	8	[1.8–68.6]	[1.3–54.5]	8	[1.2–67.2]	[4.8–101.0]	
GFR > 60	22.6	17.5	0.01	15.5	18.4	0.63	20.2	17.8	0.553
mL/min, n = 102	[2.8–101.0]	[3.7–66.7]	8	[3.2–68.6]	[7.5–38.7]	0	[3.2–66.7]	[3.7–101.0]	
GFR < 60	19.3	20.7	0.53	19.8	20.0	0.98	19.3	21.4	0.221
mL/min, n = 208	[1.2–62.0]	[1.8–67.2]	2	[1.8–62.0]	[1.3–54.5]	8	[1.2–67.2]	[3.8–54.5]	
pCG (µg/mL)									
All, n = 310	0.89	0.71	0.36	0.72	0.66	0.48	0.80	0.69	0.786
	[0.00–9.10]	[0.00–6.80]	8	[0.00–7.04]	[0.00–5.75]	8	[0.00–9.10]	[0.00–5.17]	
Female, n = 116	0.84	0.60	0.43	0.56	0.60	0.99	0.79	0.62	0.833
	[0.00–6.89]	[0.00–4.19]	1	[0.00–3.05]	[0.00–2.75]	1	[0.00–6.89]	[0.00–5.17]	
< 50, n = 59	0.77	0.55	0.61	0.52	0.98	0.51	0.53	0.67	0.992
	[0.00–1.46]	[0.00–1.48]	1	[0.00–2.88]	[0.00–2.75]	7	[0.00–6.89]	[0.00–2.88]	

> 50, n = 57	0.87 [0.00–5.17]	0.87 [0.00–4.19]	0.60 5	0.61 [0.00–3.10]	0.37 [0.13–0.84]	0.29 5	0.84 [0.00–6.22]	0.56 [0.00–5.17]	0.894
Male, n = 194	0.90 [0.00–9.10]	0.75 [0.00–6.80]	0.57 6	0.79 [0.00–7.04]	0.69 [0.00–5.75]	0.31 2	0.80 [0.00–9.10]	0.78 [0.00–5.14]	0.772
< 50, n = 79	0.72 [0.00–4.51]	0.76 [0.00–6.80]	0.67 2	0.12 [0.00–6.80]	0.85 [0.00–4.38]	0.75 1	0.79 [0.00–6.80]	0.64 [0.00–4.38]	0.930
> 50, n = 115	0.97 [0.00–9.10]	0.69 [0.00–4.27]	0.29 3	0.94 [0.00–7.04]	0.69 [0.00–5.75]	0.27 5	0.80 [0.00–9.10]	0.90 [0.00–5.14]	0.651
ABD, n = 39	0.81 [0.00–7.04]	1.03 [0.00–3.99]	0.78 2	0.90 [0.00–7.04]	0.93 [0.00–1.58]	0.48 9	0.79 [0.00–7.04]	0.93 [0.06–2.88]	0.403
No ABD, n = 271	0.90 [0.00–9.10]	0.70 [0.00–6.80]	0.33 6	0.67 [0.00–6.80]	0.63 [0.00–5.75]	0.70 1	0.80 [0.00–9.10]	0.67 [0.00–5.17]	0.606
GFR > 60 mL/min, n = 102	0.70 [0.00–6.89]	0.72 [0.00–4.65]	0.49 2	0.61 [0.00–3.53]	0.98 [0.00–5.75]	0.89 4	0.76 [0.00–6.89]	0.60 [0.00–3.84]	0.239
GFR < 60 mL/min, n = 208	0.92 [0.00–9.10]	0.71 [0.00–6.80]	0.54 3	0.82 [0.00–7.04]	0.58 [0.00–5.14]	0.37 5	1.31 [0.00–9.1]	1.29 [0.00–5.17]	0.744
HA (µg/mL)									
All, n = 310	25.6 [0.4–195.0]	25.7 [1.0–139.0]	0.84 2	28.0 [1.8–139.0]	25.7 [0.4–100.0]	0.93 2	24.0 [0.4–195.0]	30.7 [1.1–100.0]	0.471
Female, n = 116	20.5 [1.8–100.0]	22.4 [1.1–139.0]	0.68 7	22.2 [1.8–139.0]	34.4 [4.1–80.8]	0.45 1	19.1 [1.8–139.0]	30.7 [1.1–98.7]	0.184
< 50, n = 59	17.1 [2.0–100.0]	24.0 [1.1–139.0]	0.68 2	22.2 [2.0–139.0]	50.8 [4.04–80.8]	0.32 5	19.7 [2.0–139.0]	24.9 [1.1–98.7]	0.574
> 50, n = 57	23.3 [1.8–83.2]	20.8 [1.1–100.0]	0.81 2	25.0 [1.8–100.0]	17.5 [5.9–34.4]	0.47 7	18.5 [1.8–117.0]	34.0 [1.1–90.1]	0.199
Male, n = 194	28.1 [0.4–195.0]	29.1 [1.0–100.0]	0.86 9	29.1 [1.8–124.0]	25.6 [0.4–100.0]	0.49 4	28.4 [0.4–195.0]	30.6 [2.9–100.0]	0.821
< 50, n = 79	22.0 [0.5–195.0]	25.7 [1.0–100.0]	0.54 1	22.4 [1.8–124.0]	25.7 [2.9–78.6]	0.94 6	22.8 [0.5–195.0]	25.7 [2.9–100.0]	0.697
> 50, n = 115	38.4 [0.4–126.0]	36.1 [2.4–100.0]	0.48 6	37.0 [2.4–63.4]	19.1 [7.0–36.9]	0.24 6	38.4 [0.4–126.0]	37.3 [3.4–76.7]	0.954
ABD, n = 39	25.8 [3.2–82.2]	20.6 [1.1–63.4]	0.32 3	24.7 [1.8–139.0]	25.7 [0.4–100.0]	0.87 1	24.5 [3.2–82.2]	19.1 [1.1–24.0]	0.129

<i>No ABD, n = 271</i>	25.3 [0.4–195.0]	27.3 [1.0–139.0]	0.66 1	24.6 [1.8–139.0]	21.1 [3.36–98.4]	0.76 6	24.0 [0.4–195.0]	32.8 [1.1–100.0]	0.315
<i>GFR > 60 mL/min, n = 102</i>	23.1 [1.8–100.0]	21.3 [1.0–139.0]	0.76 9	30.0 [1.8–124.0]	33.6 [0.4–100.0]	0.86 3	21.4 [1.0–139.0]	21.1 [1.1–100.0]	0.872
<i>GFR < 60 mL/min, n = 208</i>	28.2 [0.4–195.0]	29.9 [2.4–100.0]	0.62 2	28.2 [0.4–195.0]	29.9 [2.4–100.0]	0.62 2	25.0 [0.4–195.0]	33.9 [2.9–94.3]	0.274
TMAO (µg/mL)									
<i>All, n = 310</i>	4.4 [0.0–32.5]	4.2 [0.0–54.0]	0.57 7	4.2 [0.0–22.7]	4.1 [0.0–32.5]	0.53 4	4.3 [0.0–54.0]	4.5 [0.0–32.4]	0.433
<i>Female, n = 116</i>	3.3 [0.0–31.6]	4.2 [0.0–34.1]	0.52 5	3.3 [0.0–15.2]	3.8 [0.0–14.7]	0.51 5	3.5 [0.0–31.6]	5.1 [0.0–32.4]	0.110
<i>< 50, n = 59</i>	3.2 [0.0–29.0]	4.8 [0.1–34.1]	0.10 3	3.7 [0.1–15.2]	3.8 [0.0–14.7]	0.78 6	3.5 [0.1–15.2]	7.6 [0.5–32.4]	0.006
<i>> 50, n = 57</i>	3.5 [0.0–31.6]	3.3 [0.0–15.4]	0.38 5	3.2 [0.0–12.7]	3.7 [0.4–9.7]	0.96 9	4.2 [0.0–31.6]	3.4 [0.0–7.7]	0.519
<i>Male, n = 194</i>	5.1 [0.0–32.5]	4.3 [0.0–54.0]	0.22 1	4.4 [0.0–22.7]	4.3 [0.0–32.5]	0.96 3	4.7 [0.0–54.0]	4.4 [0.0–20.5]	0.954
<i>< 50, n = 79</i>	4.3 [0.0–29.1]	4.5 [0.8–54.0]	0.85 0	3.8 [0.8–22.7]	3.7 [1.6–14.9]	0.82 5	4.4 [0.0–54.0]	3.7 [1.6–16.1]	0.778
<i>> 50, n = 115</i>	5.9 [0.0–32.5]	4.2 [0.0–24.0]	0.05 8	5.0 [0.0–18.1]	4.6 [0.0–32.5]	0.76 6	4.7 [0.0–32.5]	4.5 [0.0–20.5]	0.979
<i>ABD, n = 39</i>	4.2 [0.0–31.6]	4.1 [0.4–12.3]	0.86 6	5.4 [0.0–12.3]	3.3 [0.4–4.6]	0.05 9	4.2 [0.0–31.6]	4.5 [0.4–12.3]	0.610
<i>No ABD, n = 271</i>	4.5 [0.0–32.5]	4.3 [0.0–54.0]	0.60 9	4.0 [0.0–22.7]	4.3 [0.0–32.5]	0.19 0	4.5 [0.0–54.0]	4.4 [0.0–32.4]	0.495
<i>GFR > 60 mL/min, n = 102</i>	4.0 [0.0–29.2]	4.8 [0.1–22.7]	0.91 8	4.1 [0.1–22.7]	4.3 [0.0–14.9]	0.83 1	4.0 [0.0–22.7]	5.8 [0.4–29.2]	0.090
<i>GFR < 60 mL/min, n = 208</i>	4.9 [0.0–32.5]	4.1 [0.0–54.0]	0.39 8	4.2 [0.0–17.1]	3.9 [0.0–32.5]	0.55 2	4.5 [0.0–54.0]	3.8 [0.0–32.4]	0.807
IAA (µg/mL)									
<i>All, n = 310</i>	0.75 [0.08–7.61]	0.75 [0.10–5.28]	0.30 2	0.74 [0.14–7.61]	0.75 [0.24–5.89]	0.94 0	0.74 [0.19–7.61]	0.78 [0.08–5.89]	0.808
<i>Female, n = 116</i>	0.69 [0.19–5.22]	0.77 [0.10–2.83]	0.87 6	0.67 [0.14–2.52]	0.71 [0.35–1.80]	0.62 7	0.71 [0.19–5.22]	0.78 [0.14–2.52]	0.365

< 50, n = 59	0.70 [0.21–5.22]	0.74 [0.10–2.83]	0.52 2	0.71 [0.21–2.52]	0.81 [0.35–1.80]	0.60 8	0.71 [0.21–5.22]	0.88 [0.34–2.52]	0.190
> 50, n = 57	0.68 [0.19–2.18]	0.77 [0.14–1.69]	0.69 4	0.65 [0.14–2.18]	0.64 [0.40–0.88]	0.85 2	0.78 [0.19–2.11]	0.68 [0.14–2.18]	0.894
Male, n = 194	0.80 [0.08–7.61]	0.73 [0.22–5.28]	0.14 4	0.76 [0.33–7.61]	0.78 [0.24–5.89]	0.65 3	0.75 [0.21–7.61]	0.78 [0.08–5.89]	0.798
< 50, n = 79	0.75 [0.22–2.63]	0.84 [0.36–3.20]	0.68 3	0.74 [0.40–1.69]	0.86 [0.36–3.20]	0.49 9	0.74 [0.22–2.63]	0.89 [0.36–3.20]	0.537
> 50, n = 115	0.83 [0.08–7.61]	0.68 [0.22–5.28]	0.02 6	0.78 [0.24–5.89]	0.71 [0.24–5.89]	0.30 7	0.76 [0.21–7.61]	0.74 [0.08–5.89]	0.296
ABD, n = 39	0.68 [0.21–2.12]	0.89 [0.33–5.28]	0.70 2	0.95 [0.33–5.28]	0.88 [0.53–2.12]	1.00 0	0.94 [0.33–5.28]	0.64 [0.21–1.33]	0.405
No ABD, n = 271	0.76 [0.08–7.61]	0.74 [0.10–5.26]	0.21 6	0.74 [0.14–7.61]	0.73 [0.24–5.89]	0.93 9	0.73 [0.19–7.61]	0.78 [0.08–5.89]	0.530
GFR > 60 mL/min, n = 102	0.74 [0.21–2.63]	0.70 [0.33–4.75]	0.69 7	0.75 [0.21–4.75]	0.63 [0.35–2.12]	0.10 3	0.72 [0.21–4.75]	0.78 [0.42–1.69]	0.447
GFR < 60 mL/min, n = 208	0.82 [0.08–7.6]	0.77 [0.10–5.28]	0.30 6	0.69 [0.14–7.61]	0.82 [0.24–5.89]	0.34 5	0.77 [0.19–7.61]	0.78 [0.08–5.89]	0.795

ABD, adynamic bone disease; CMPF, 3-carboxy-4-methyl-5-propyl-furanpropionic acid; GFR, glomerular filtration rate; HA, hippuric acid; IAA, indole-3-acetic acid; IxS, indoxylsulfate; pCG, p-cresylglucuronide; pCS, p-cresylsulfate; r, correlation coefficient; TMAO, trimethylamine-N-oxide.

Table S12. Correlations between UT concentrations and BMD changes 12 and 24 months after transplantation, by subgroup.

Subgroups	Uremic Toxins													
	pCS		CMPF		IxS		pCG		HA		TMAO		IAA	
	rho	p	rho	p	rho	p	rho	p	rho	p	rho	p	rho	p
Changes in the lumbar spine BMD (%) 12 months after transplantation														
All, n = 310	-0.02	0.747	-0.09	0.116	+0.02	0.736	-0.03	0.624	+0.02	0.666	-0.01	0.901	-0.03	0.569
Female, n = 116	-0.12	0.215	-0.05	0.595	-0.09	0.337	-0.12	0.200	+0.03	0.781	-0.01	0.891	-0.04	0.660
< 50, n = 59	-0.12	0.371	-0.01	0.943	-0.17	0.200	-0.20	.0135	-0.01	0.914	+0.11	0.399	-0.04	0.742
> 50, n = 57	-0.09	0.527	-0.18	0.197	-0.06	0.662	-0.04	0.747	+0.06	0.663	-0.20	0.149	-0.07	0.612
Male, n = 194	+0.02	0.770	-0.11	0.125	+0.07	0.329	+0.01	0.870	-0.05	0.533	-0.00	0.962	-0.03	0.694
< 50, n = 79	+0.08	0.486	-0.04	0.708	+0.11	0.327	+0.11	0.337	+0.01	0.920	+0.02	0.837	+0.13	0.254
> 50, n = 115	-0.02	0.816	-0.12	0.186	+0.03	0.775	-0.05	0.613	-0.09	0.340	-0.04	0.667	-0.07	0.467
ABD, n = 39	+0.27	0.104	-0.12	0.487	+0.10	0.571	+0.01	0.975	-0.16	0.354	-0.12	0.488	+0.10	0.557

<i>No ABD, n = 271</i>	-0.05	0.400	-0.10	0.118	+0.00	0.943	-0.03	0.602	-0.02	0.761	+0.01	0.927	-0.05	0.419
<i>ESW, n = 41</i>	-0.08	0.634	+0.09	0.591	+0.09	0.590	-0.01	0.947	+0.01	0.930	+0.18	0.272	+0.10	0.539
<i>OSR, n = 269</i>	-0.01	0.868	-0.08	0.166	+0.04	0.486	-0.02	0.787	-0.02	0.730	-0.01	0.874	-0.08	0.195
<i>GFR > 60 mL/min, n = 102</i>	-0.15	0.127	+0.01	0.908	-0.10	0.344	-0.02	0.831	+0.06	0.533	+0.08	0.436	-0.01	0.958
<i>GFR < 60 mL/min, n = 208</i>	+0.04	0.584	-0.15	0.033	+0.07	0.285	-0.02	0.744	-0.06	0.390	-0.03	0.625	-0.03	0.645
Changes in the lumbar spine BMD (%) 24 months after transplantation														
<i>All, n = 222</i>	-0.00	0.967	-0.10	0.135	-0.03	0.662	+0.03	0.621	-0.03	0.614	+0.07	0.320	-0.06	0.368
<i>Female, n = 86</i>	+0.02	0.857	-0.06	0.553	-0.11	0.298	+0.05	0.657	-0.02	0.869	+0.04	0.704	-0.17	0.116
<i>< 50, n = 46</i>	+0.00	0.980	-0.05	0.759	-0.17	0.272	+0.01	0.953	-0.14	0.371	+0.04	0.783	-0.20	0.195
<i>> 50, n = 40</i>	+0.06	0.715	-0.12	0.462	-0.09	0.566	+0.10	0.558	+0.10	0.526	+0.03	0.876	-0.17	0.291
<i>Male, n = 136</i>	-0.02	0.826	-0.12	0.148	+0.01	0.937	+0.02	0.779	-0.05	0.582	+0.08	0.361	-0.01	0.932
<i>< 50, n = 60</i>	+0.11	0.417	+0.00	0.997	+0.06	0.623	+0.11	0.416	+0.01	0.967	+0.12	0.354	-0.9	0.517
<i>> 50, n = 76</i>	-0.14	0.214	-0.17	0.135	-0.08	0.487	-0.03	0.810	-0.12	0.309	-0.01	0.964	-0.05	0.675
<i>ABD, n = 26</i>	+0.00	0.983	+0.30	0.134	-0.25	0.219	+0.00	0.991	-0.18	0.387	+0.00	0.997	-0.10	0.628
<i>No ABD, n = 196</i>	-0.00	0.960	-0.16	0.023	-0.00	0.991	+0.04	0.544	-0.03	0.724	+0.08	0.276	-0.06	0.436
<i>ESW, n = 16</i>	-0.19	0.475	+0.68	0.003	+0.23	0.376	+0.32	0.232	+0.36	0.171	+0.18	0.515	+0.01	0.969
<i>OSR, n = 206</i>	+0.02	0.798	-0.10	0.139	-0.01	0.856	+0.05	0.440	-0.03	0.697	+0.08	0.259	-0.05	0.494
<i>GFR > 60 mL/min, n = 76</i>	+0.04	0.751	+0.04	0.761	-0.17	0.144	+0.02	0.869	+0.01	0.925	+0.17	0.141	+0.08	0.493
<i>GFR < 60 mL/min, n = 146</i>	-0.02	0.797	-0.18	0.028	+0.05	0.578	+0.05	0.544	-0.06	0.501	+0.03	0.733	-0.12	0.134
Changes in the femoral neck BMD (%) 12 months after transplantation														
<i>All, n = 310</i>	-0.10	0.229	+0.10	0.218	+0.04	0.654	-0.01	0.908	-0.03	0.760	+0.07	0.397	+0.01	0.869
<i>Female, n = 116</i>	-0.14	0.347	+0.22	0.131	+0.23	0.124	+0.00	0.984	+0.12	0.437	+0.02	0.906	-0.10	0.485
<i>< 50, n = 59</i>	+0.04	0.853	+0.22	0.309	+0.18	0.417	+0.15	0.498	-0.01	0.976	+0.14	0.514	-0.11	0.599
<i>> 50, n = 57</i>	-0.21	0.320	-0.03	0.901	+0.13	0.560	-0.18	0.389	+0.13	0.530	-0.29	0.177	-0.21	0.330
<i>Male, n = 194</i>	-0.11	0.297	+0.00	0.950	+0.05	0.614	-0.03	0.766	-0.03	0.775	+0.08	0.455	+0.02	0.808
<i>< 50, n = 79</i>	-0.06	0.716	+0.22	0.176	-0.08	0.634	+0.00	0.994	-0.01	0.967	+0.16	0.334	+0.25	0.123
<i>> 50, n = 115</i>	-0.14	0.294	-0.10	0.433	-0.03	0.832	-0.05	0.701	-0.05	0.724	+0.02	0.870	-0.03	0.820
<i>ABD, n = 39</i>	+0.01	0.972	+0.00	0.973	-0.03	0.920	+0.06	0.806	-0.13	0.617	-0.10	0.688	-0.13	0.596
<i>No ABD, n = 271</i>	-0.10	0.246	+0.10	0.256	+0.05	0.569	-0.01	0.915	+0.02	0.787	+0.08	0.376	+0.04	0.686
<i>ESW, n = 41</i>	+0.04	0.848	+0.38	0.052	+0.31	0.136	+0.10	0.642	+0.13	0.536	+0.33	0.104	-0.07	0.730

<i>OSR, n = 269</i>	-0.12	0.198	+0.09	0.350	+0.01	0.907	-0.03	0.780	+0.00	0.967	+0.04	0.646	+0.03	0.747
<i>GFR > 60 mL/min, n = 102</i>	-0.25	0.083	+0.18	0.224	-0.05	0.711	-0.05	0.732	-0.13	0.386	+0.06	0.664	-0.04	0.779
<i>GFR < 60 mL/min, n = 208</i>	-0.04	0.719	+0.04	0.673	+0.10	0.357	+0.01	0.926	-0.11	0.265	+0.07	0.470	+0.05	0.658
Changes in the femoral neck BMD (%) 24 months after transplantation														
<i>All, n = 222</i>	+0.03	0.747	-0.03	0.733	+0.11	0.244	+0.06	0.533	+0.13	0.173	+0.07	0.443	+0.05	0.576
<i>Female, n = 86</i>	+0.03	0.859	-0.10	0.553	+0.18	0.277	+0.13	0.410	+0.33	0.038	+0.15	0.341	+0.25	0.119
<i>< 50, n = 46</i>	-0.12	0.594	-0.19	0.382	+0.29	0.185	-0.07	0.766	+0.26	0.238	+0.22	0.314	+0.38	0.075
<i>> 50, n = 40</i>	+0.22	0.399	+0.06	0.805	+0.09	0.737	+0.33	0.195	+0.37	0.145	+0.09	0.722	+0.08	0.755
<i>Male, n = 136</i>	+0.03	0.783	+0.02	0.893	+0.08	0.484	+0.03	0.813	+0.02	0.861	-0.01	0.946	-0.03	0.808
<i>< 50, n = 60</i>	+0.22	0.231	+0.37	0.041	+0.18	0.322	+0.13	0.480	+0.12	0.530	-0.01	0.975	+0.25	0.168
<i>> 50, n = 76</i>	-0.11	0.496	-0.05	0.772	-0.03	0.852	-0.03	0.852	-0.11	0.496	-0.03	0.856	-0.13	0.423
<i>ABD, n = 26</i>	+0.08	0.771	+0.02	0.942	-0.27	0.297	-0.16	0.533	-0.31	0.223	-0.00	0.998	-0.29	0.257
<i>No ABD, n = 196</i>	+0.03	0.798	+0.04	0.704	+0.18	0.077	+0.14	0.174	+0.19	0.069	+0.09	0.381	+0.08	0.416
<i>ESW, n = 16</i>	-0.24	0.458	+0.45	0.135	+0.41	0.187	+0.25	0.435	+0.39	0.209	+0.79	0.002	+0.33	0.288
<i>OSR, n = 206</i>	+0.06	0.531	+0.05	0.630	+0.09	0.356	+0.06	0.580	+0.11	0.267	+0.03	0.759	+0.04	0.669
<i>GFR > 60 mL/min, n = 76</i>	+0.21	0.182	+0.09	0.552	+0.14	0.372	-0.07	0.642	+0.02	0.897	+0.00	0.989	+0.07	0.650
<i>GFR < 60 mL/min, n = 146</i>	-0.05	0.662	-0.13	0.280	+0.11	0.383	+0.15	0.218	+0.21	0.090	+0.11	0.375	+0.04	0.727
Changes in the total hip BMD (%) 12 months after transplantation														
<i>All, n = 310</i>	-0.05	0.389	-0.02	0.770	-0.02	0.763	-0.04	0.545	-0.07	0.257	-0.00	0.976	+0.07	0.238
<i>Female, n = 116</i>	+0.04	0.686	+0.06	0.547	-0.17	0.094	-0.05	0.641	+0.04	0.712	-0.02	0.834	+0.11	0.295
<i>< 50, n = 59</i>	+0.07	0.618	-0.03	0.833	+0.00	0.986	-0.22	0.123	-0.05	0.731	+0.28	0.052	+0.09	0.540
<i>> 50, n = 57</i>	+0.09	0.538	+0.05	0.727	+0.28	0.048	+0.09	0.557	+0.08	0.594	-0.31	0.025	+0.08	0.575
<i>Male, n = 194</i>	-0.08	0.286	-0.03	0.653	-0.07	0.333	-0.03	0.702	-0.10	0.176	+0.02	0.792	+0.08	0.311
<i>< 50, n = 79</i>	-0.14	0.260	-0.09	0.479	-0.14	0.235	-0.13	0.275	-0.21	0.078	+0.00	0.968	-0.03	0.778
<i>> 50, n = 115</i>	-0.03	0.764	-0.01	0.956	-0.02	0.869	+0.05	0.587	+0.01	0.915	+0.04	0.706	+0.13	0.182
<i>ABD, n = 39</i>	-0.01	0.951	+0.04	0.832	-0.34	0.064	+0.01	0.953	-0.35	0.051	-0.11	0.552	-0.12	0.531
<i>No ABD, n = 271</i>	-0.05	0.396	-0.04	0.506	+0.02	0.792	-0.05	0.452	-0.06	0.321	+0.01	0.893	+0.10	0.112
<i>ESW, n = 41</i>	+0.13	0.426	+0.41	0.012	+0.27	0.109	+0.09	0.613	+0.17	0.323	-0.06	0.716	+0.19	0.250
<i>OSR, n = 269</i>	-0.09	0.186	-0.06	0.362	-0.05	0.436	-0.05	0.432	-0.11	0.098	+0.01	0.930	+0.04	0.572

GFR > 60 mL/min, n = 102	-0.17	0.117	+0.03	0.802	-0.17	0.105	-0.19	0.078	-0.07	0.500	+0.20	0.058	-0.09	0.398
GFR < 60 mL/min, n = 208	+0.01	0.935	-0.04	0.570	+0.08	0.302	+0.03	0.673	-0.07	0.367	-0.09	0.210	+0.13	0.076
Changes in the total hip BMD (%) 24 months after transplantation														
All, n = 222	-0.05	0.509	-0.02	0.730	+0.04	0.570	+0.01	0.868	+0.02	0.743	+0.03	0.671	-0.01	0.944
Female, n = 86	-0.02	0.886	-0.06	0.610	+0.06	0.598	-0.07	0.561	+0.12	0.303	+0.05	0.690	+0.09	0.437
< 50, n = 46	+0.06	0.736	+0.08	0.618	-0.07	0.687	-0.25	0.132	+0.13	0.403	+0.23	0.174	+0.08	0.639
> 50, n = 40	-0.04	0.834	-0.24	0.167	+0.22	0.206	+0.14	0.435	+0.10	0.562	-0.21	0.225	+0.08	0.628
Male, n = 136	-0.05	0.596	+0.01	0.938	+0.06	0.519	+0.05	0.551	+0.02	0.984	+0.03	0.733	-0.05	0.592
< 50, n = 60	-0.05	0.704	-0.12	0.376	+0.04	0.755	-0.03	0.802	-0.06	0.652	-0.05	0.704	-0.17	0.203
> 50, n = 76	-0.05	0.699	+0.11	0.362	+0.04	0.735	+0.11	0.348	+0.06	0.637	+0.11	0.380	-0.00	0.996
ABD, n = 26	+0.11	0.633	+0.25	0.276	-0.26	0.245	+0.06	0.794	-0.17	0.460	+0.02	0.926	-0.17	0.474
No ABD, n = 196	-0.07	0.378	-0.06	0.435	+0.08	0.299	+0.00	0.975	+0.03	0.679	+0.03	0.692	+0.01	0.857
ESW, n = 16	-0.13	0.625	+0.48	0.058	+0.47	0.069	+0.32	0.221	+0.40	0.124	+0.30	0.260	+0.34	0.196
OSR, n = 206	-0.04	0.613	-0.03	0.688	+0.04	0.612	+0.02	0.839	+0.02	0.787	+0.03	0.718	-0.01	0.919
GFR > 60 mL/min, n = 76	-0.02	0.871	-0.04	0.739	-0.01	0.942	-0.00	0.995	+0.06	0.635	+0.12	0.332	-0.12	0.364
GFR < 60 mL/min, n = 146	-0.06	0.485	-0.05	0.575	+0.06	0.479	+0.03	0.694	-0.00	0.994	-0.01	0.888	+0.05	0.530

ABD, adynamic bone disease; CMPF, 3-carboxy-4-methyl-5-propyl-furanpropionic acid; ESW, early steroids withdrawal; GFR, glomerular filtration rate; HA, hippuric acid; IAA, indole-3-acetic acid; IxS, indoxylsulfate; OSR, other steroid regimens; pCG, p-cresylglucuronide; pCS, p-cresylsulfate; r, correlation coefficient; TMAO, trimethylamine-N-oxide.