Supplemental Material

Table of Content

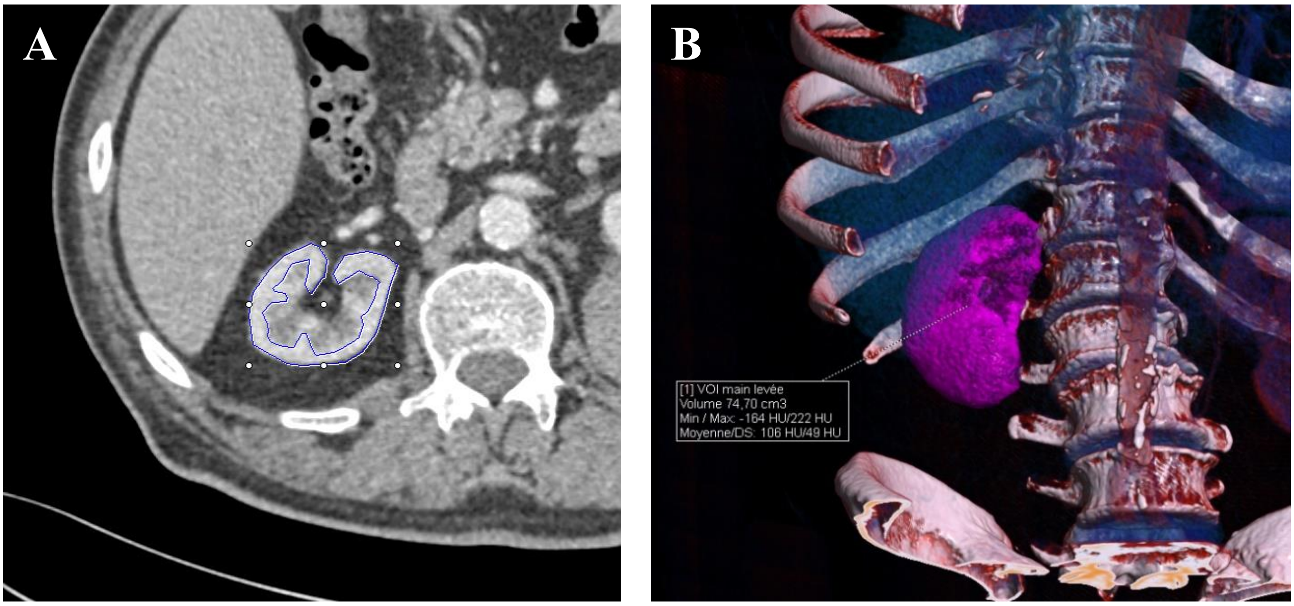
Supplemental Table 1: Number of annotated objects in each category for Training and Test cohorts

	First Convolutional Neural Network		Second Convolutional Neural Network	
	Training cohort (220 ROI)	Test cohort (54 ROI)	Training cohort (173 ROI)	Test cohort (67 ROI)
Cortical area	206	69		
Medullary area	82	32		
Capsule	121	57		
Non-sclerotic glomeruli			268	106
Complete glomeruli (tuft)			99	55
Partial glomeruli (tuft)			197	74
Globally sclerotic glomeruli			83	10
Normal Tubules			5290	2890
Atrophic tubules			4260	989
Small/medium size arteries			304	109
External elastic lamina			139	60
internal elastic lamina			257	86
Veins			112	35

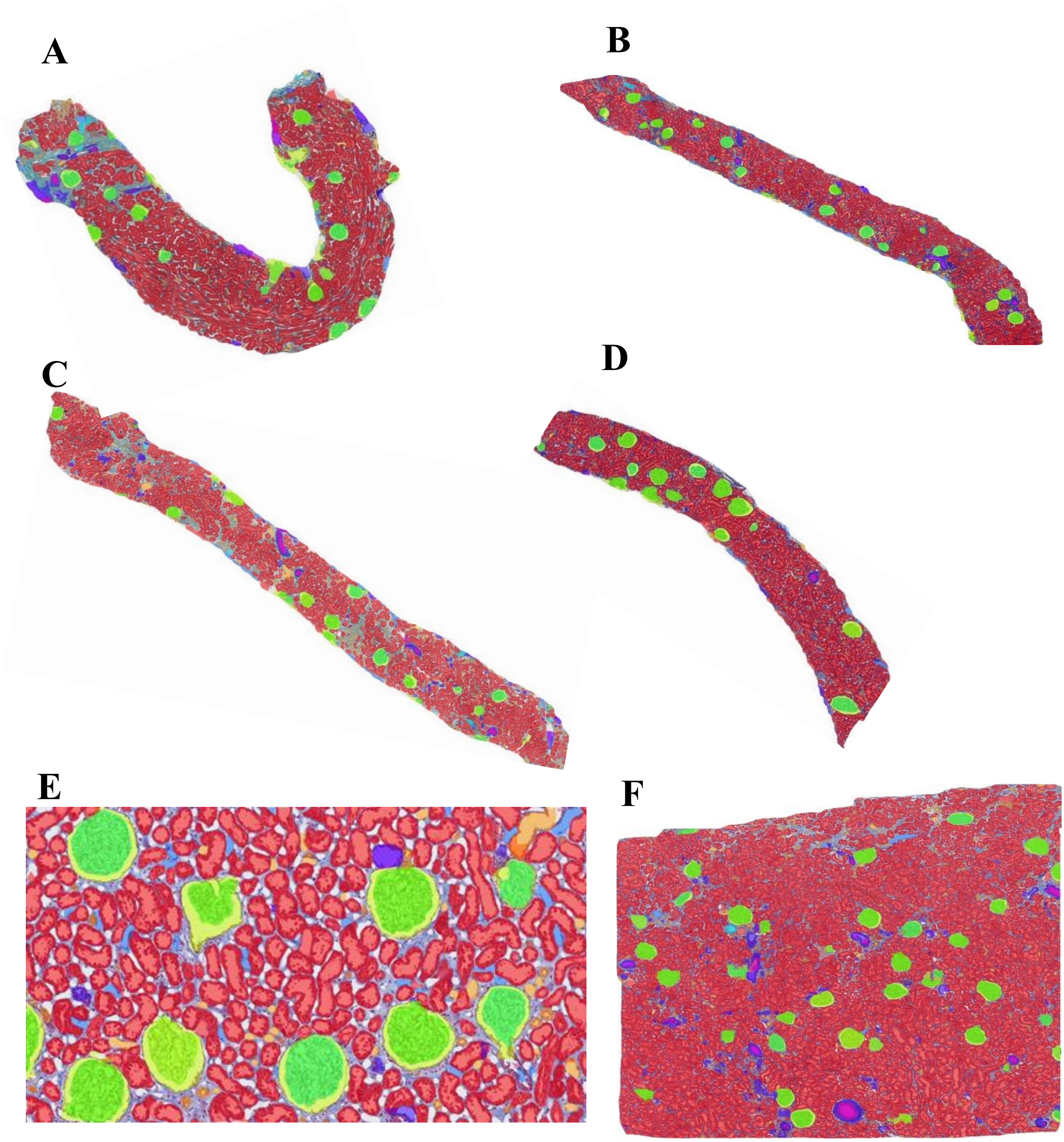
First Convolutional Neural Network for cortical area recognition and the second for recognition of cortical elements of interest.

Supplemental Table 2: Formulas for parameters of interest(1–4)

Parameters	Formulas	Description
Mean glomerular area (*Aglom*)(1)	$\frac{Aglom\_complete + Aglom\_partial}{total\ number\ of\ non-sclerotic\ glomeruli}$	Aglom_complete= areas of Tufts of complete glomeruli Aglom_partial= areas of Tufts of partial glomeruli
Mean glomerular volum (Weibel-Gomes formula) (1,3)	$Aglom^{3/2}\ x\ \frac{\beta}{d}$	*β=1.382 (shape coefficient for spheres)* *d*= 1.01 (coefficient of adjustment on the size of the glomeruli)
Glomerular density (*Dglom*)(1)	$Dglom = \frac{1}{\beta}\ x\ \sqrt[2]{\frac{\left(\frac{number\ of\ non-sclerotic\ glomeruli}{cortical\ area}\right)^3}{\frac{total\ area\ of\ non-sclerotic\ glomeruli}{cortical\ area}}}$	*β=1.382 (shape coefficient for spheres) ** number of non-sclerotic glomeruli: =1 if complete glomeruli =0.5 if partial glomeruli
Total nephron number(2)	$\frac{Glomerular\ density * cortical\ volume}{a * b}$	a= 1.43 (reduction coefficient linked to histological staining) b=1.268 (coefficient of reduction related to tissue perfusion pressure loss)
Tubular atrophy(4)	$\frac{number\ of\ atrophic\ tubule}{total\ tubule\ number}$	
Interstitial area(4)	Cortical area-arteries area - veins area-tubules area - non sclerotic glomeruli area - globally sclerotic glomeruli area	
Interstitial fibrosis (%)(4)	$\frac{Interstitial\ area}{cortical\ area}$	
Intimal thickening (luminal stenosis) (2)	1- $\frac{Aext-Aint}{Aext}$	Aint= area of internal elastic membrane Aext= area of external elastic membrane



Supplemental Figure 1: Evaluation of the cortical volume of the non-tumoral kidney on a CT-Scan. The renal cortex is delimited manually according to its enhancement in the arterial injection phase (A). Reconstitution of a three-dimensional volume measured by the software (Syngo.via, Siemens Healthineers) (B).



Supplemental Figure 2: Kidney cortical samples from the Application cohort after evaluation with the Convolutional Neural Networks. Four patients with a kidney biopsy (A-D) (x10 magnitude) and two sample from nephrectomized patients at x100 and x25 magnitude (E and F). Normal tubules (red), atrophic tubules (orange), bowman capsule (yellow), non-sclerotic glomeruli (light green) and globally sclerotic glomeruli (light blue), internal limitant lamina (pink), external limitant lamina (purple), vein (deep blue).

Supplemental bibliography:

1. Issa N, Lopez CL, Denic A, Taler SJ, Larson JJ, Kremers WK, et al. Kidney Structural Features from Living Donors Predict Graft Failure in the Recipient. J Am Soc Nephrol. févr 2020;31(2):415-23.

2. Merzkani MA, Denic A, Narasimhan R, Lopez CL, Larson JJ, Kremers WK, et al. Kidney Microstructural Features at the Time of Donation Predict Long-term Risk of Chronic Kidney Disease in Living Kidney Donors. Mayo Clin Proc. janv 2021;96(1):40-51.

3. Weibel ER, Gomez DM. A principle for counting tissue structures on random sections. Journal of Applied Physiology. 1 mars 1962;17(2):343-8.

4. Hermsen M, Bel T de, Boer M den, Steenbergen EJ, Kers J, Florquin S, et al. Deep Learning–Based Histopathologic Assessment of Kidney Tissue. JASN. 1 oct 2019;30(10):1968-79.