# Supplementary Methods

### Segmentation of bone and intracranial tissue types

All image segmentation was performed with a combination of Freesurfer, FSL and Matlab tools (The MathWorks Inc., Natick, MA, USA) on T1, PD and T1/PD datasets.

To isolate the brain, skull stripping was performed on the T1/PD dataset 1 using a hybrid watershed/surface deformation procedure 2 implemented in the Freesurfer image analysis suite, which is freely available for download online ([http://surfer.nmr.mgh.harvard.edu](http://surfer.nmr.mgh.harvard.edu/)). Using the FMRIB Automated Segmentation Tool (FAST) 3, the extracted brain was then divided into the three compartments gray matter, white matter and liquor. Next, using the betsurf algorithm of the Brain Extraction Tool 2 (BET2) 4,5, the PD dataset was divided into “outskull”, skull and “inskull” compartments. BET2 and FAST were used as part of the FMRIB Software Library (FSL) version 4.1.5 6,7. Air cavities within the bone compartment were added to the model using regional growth. Note that we could not segment soft and hard bone based on the available imaging data, as a strong water-fat shift was present. This should not, however, affect our results on the role of blood vessels (discussed in the Limitations section of the Discussion). Due to the contrast differences between T1 and PD weighted images, brain extraction by Freesurfer and BET2 differed. In PD imaging, the dura intensity is close to the CSF, gray and white matter, causing betsurf to extract the dura surface as part of the “inskull” compartment. In T1 imaging, the contrast between dura, CSF, gray and white matter is much stronger, resulting in a brain extraction essentially without the dura. Taking the difference between the two extractions we could, thus, recovered a faithful representation of the dura, albeit without the falx and the tentorium.

### Segmentation of extracranial tissue types

Previous studies demonstrated the importance of incorporating a sufficient amount of tissue between the lower skull and scalp for accurate simulation of electrical brain potentials 8–10. As BET2 removes the face and neck, the original extent of the head was restored from the PD dataset using a customized version of the mesh\_shrinkwrap algorithm 11 implementation for Matlab. Because of low CNR in the region of the lower mandible and throat, those regions were not included in the model, but eyes and internal air (including the air in cavities within the bone compartment) were added to the model using regional growth. The remaining “outskull” compartment was then divided into skin (surface and direct neighbors) and soft tissue (unattributed “outskull”) compartments. To in part recreate the bony structure of the nasal sinuses and parts of the jaw, any soft tissue in direct contact with internal air was replaced by bone after 3D morphological closing of the internal air compartment. Finally, as its patchy distribution prevented region-growth-based segmentation, the “bright” fatty tissue 12,13 was extracted from the soft tissue compartment by gray value thresholding.

### Meshing of models

Geometry-adapted cubic meshes, which improve the precision of the computed potentials by reducing the error due to unsmooth transition edges 14, were created using SimBio-Vgrid 15. To this end, segmented volumes were first exported from Matlab to the Analyze format using the avw\_write function (freely available at http://eeg.sourceforge.net/ as part of the Bioelectromagnetism Matlab Toolbox), then converted into the Vista format using the “anatov” converter provided by the Lipsia toolbox version 1.6 16 and finally loaded into SimBio-Vgrid. Visualizations of the meshes were performed using SCIRun 17. 3D surfaces rendered using SCIRun were smoothed using the default settings of the SCIRun FairMesh module.

### Orientation of the dipoles

The orientation of the dipoles used for forward calculation was determined using the following steps: (1) finding the closest point on the surface of the gray matter, (2) using connectivity information to identify all neighboring surface elements, (3) calculating the normal vector of each surface element and its neighbors and (4) taking the mean over these normals as the orientation of the dipole. This procedure creates an orientation that is surface-constrained and robust against local inaccuracies in topography.

### Literature

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