Use of Anatomically Correct Head Models and Higher Dielectric Values to Study SAR Difference between Children and Adult's Head and Eye Tissues

J. Keshvari and S. Lang
Nokia Research Center, Finland

The increasing use of mobile communication devices, especially mobile phones by children, has triggered discussions whether there is a larger radio frequency (RF) energy absorption in the heads of children compared to that of adults.

There have been many studies investigating SAR in child and adult heads using various exposure scenarios and head models. Most of the researchers investigating SAR in the head of adults and children have used down-scaled adult head models to represent the child head. Use of down-scaled head models in the calculation of SAR and temperature has been criticized frequently indicating that a down-scaled adult head model cannot reliably represent a child head when investigating the RF energy distribution. All of those studies have assumed the same value for dielectric parameters in child and adult head models. These are criticized in scientific communities by many researchers commenting that, children organs are not fully developed, they differ not only from anatomical point of view but also their tissue composition is different, with higher water content. Therefore, use of down-scaled head models and same dielectric values may give rise to incorrect exposure assessment and misleading conclusions in terms of health risk assessment.

The aim of this presentation is:

- To compare SAR in 4 different anatomically correct MRI based head models using the same dielectric values for all models.
- To compare SAR in 3 different anatomically correct MRI based head models when the dielectric values are increased from 5 to 20%.

A series of FDTD simulations were carried out to study the localized volume-averaged SAR distribution in 4 different MRI based head models.

The main finding of this study is that the distance of antenna from the exposed tissue, tissue composition and anatomical differences between head models can explain differences in the RF energy absorption between anatomically correct MRI-based adult and child models. In the case of eye region exposure, both anatomical parameters and tissue composition differences between the models affect the calculated SAR levels. Moreover, the results show that the head size does not appear to be a key parameter in the near-field RF exposure. In summary, there is no systematic difference in the RF energy absorption between anatomically correct MRI-based child and adult head models.

Increasing conductivity or both conductivity and permittivity at the same time would not necessarily cause an increase in SAR. In many cases the SAR decreases. Same increase in dielectric value would not cause same SAR variation in different models (individuals). The SAR variation because of increase in dielectric values is very much dependent on the anatomy and tissue layer composition of the exposed region.