

Defining anatomical domains within the foetal brain



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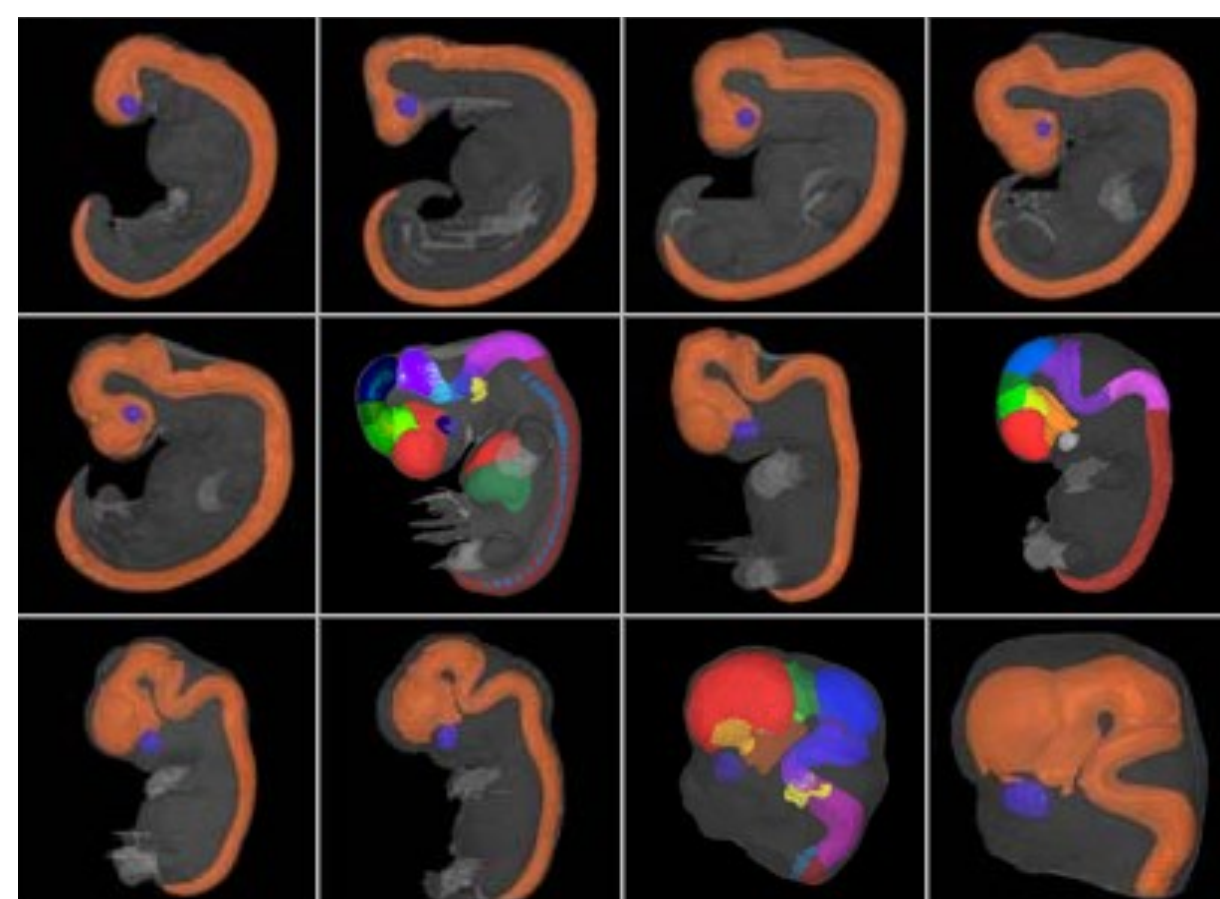


Introduction

As the foetal brain develops it undergoes complex changes in both shape and structure which can make it difficult to identify spatial locations and relate structures between different developmental stages. 3D models however can be used to help identify these changes in shape. Some genes are expressed in very specific structures of the foetal brain. These can therefore be used as markers, in combination with morphological features, to identify anatomical domains within the 3D models across these different developmental stages. Together, the 3D models and anatomical domains are powerful tools for mapping and analysing gene expression data.

Aims

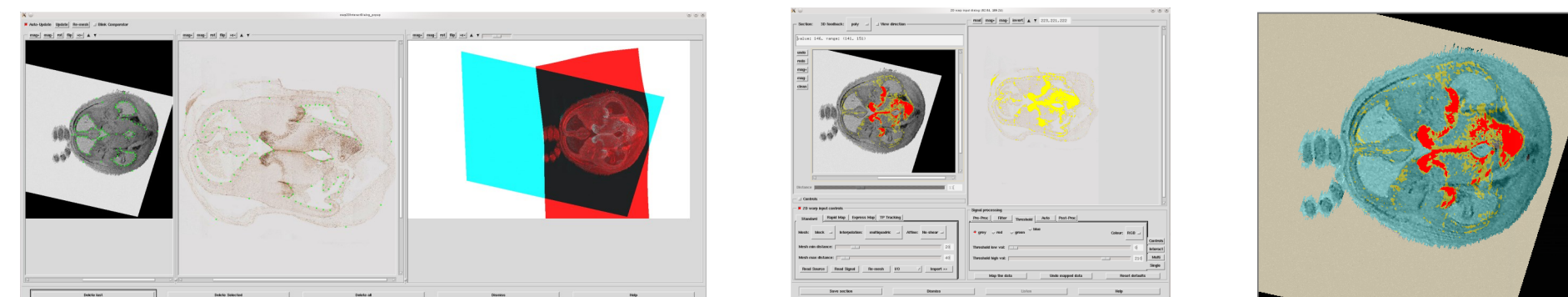
- Use MAPaint to map gene expression data onto digital models of the foetal brain at 8 and 10 weeks of development.
- Use this as a guide to define and paint the different anatomical domains onto the 3D foetal models.
- View the defined domains as a 3D representation of the development of the foetus in the 3D visualisation programme Amira.



The HuDSeN atlas displays 3D reconstructions of human development through the painting of anatomical domains onto 3D models. They show human development from Carnegie Stage 12 (26 days of development) up to Carnegie Stage 23 (56 days of development).

1- Mapping the gene expression data

To do this gene expression patterns are captured from histological sections from the foetal brain. This data is then mapped onto the 3D model by identifying each corresponding section and the using the 'warp' transformation to map this histology onto the model.



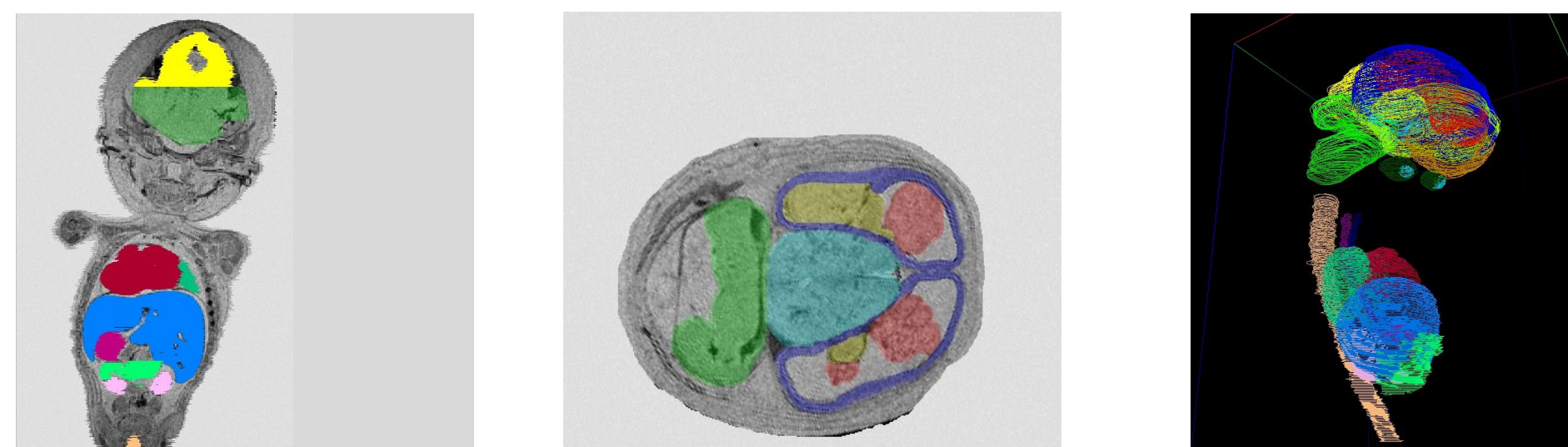
A) Tie points are added to the OPT image and correspondences in the experimental section until the jpeg fits the digital OPT section.

B) Thresholding is used to paint where the gene is being expressed.

C) OPT image showing where the gene is being expressed.

2- Painting anatomical domains using MAPaint

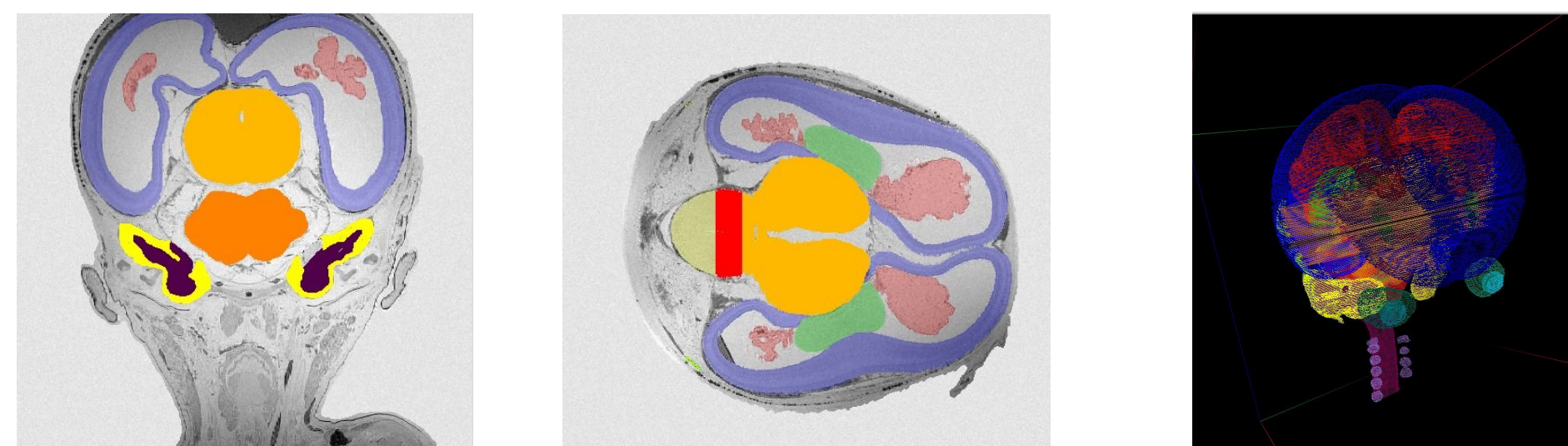
Different domains can then be defined and painted using the computer software MAPaint. These can be defined by both identifiable morphological features of the foetal brain and also gene expression patterns showing domain boundaries.



D) 8pcw model viewed in coronal (Y-Z) view

E) 8pcw model viewed in transverse (X-Y) view.

F) Painted domains of 8pcw model viewed as a 3D image



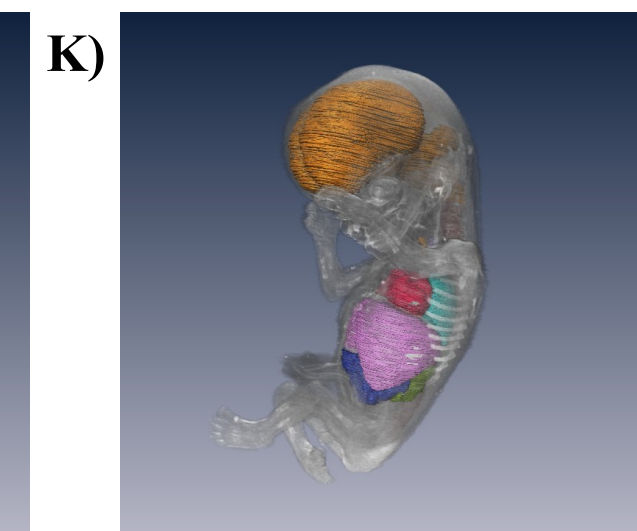
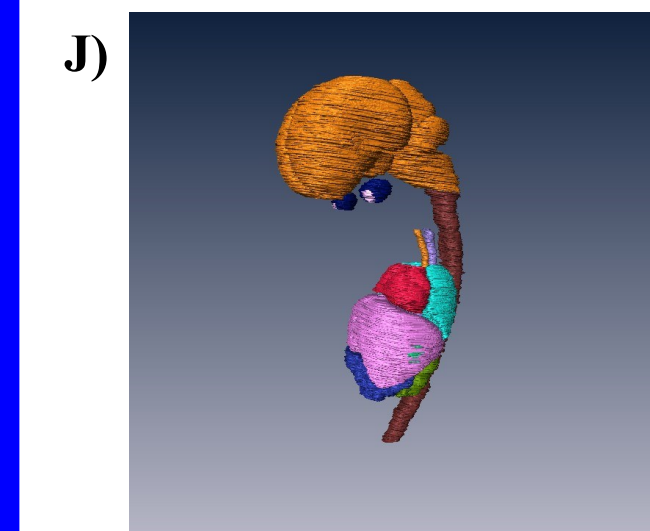
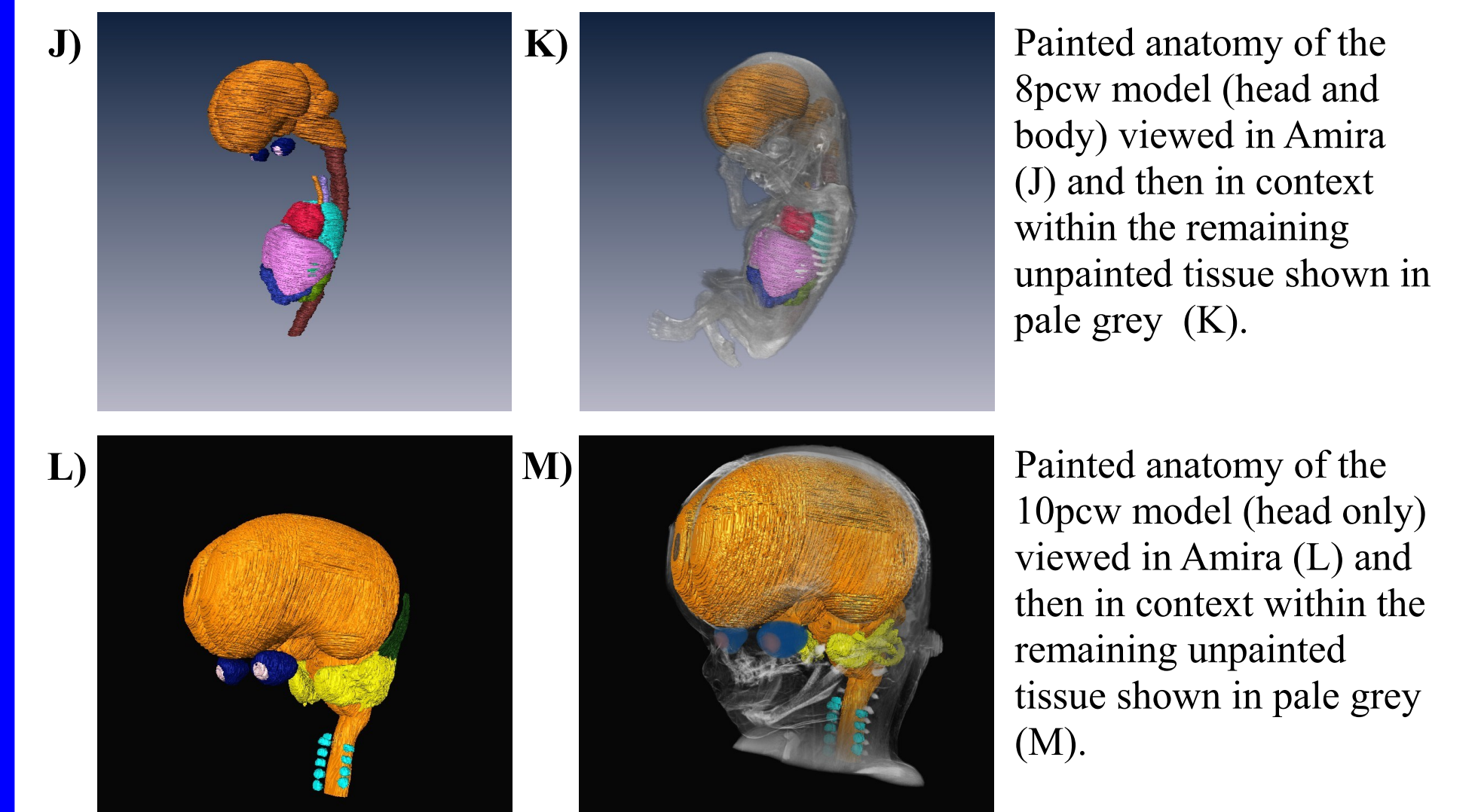
G) 10pcw model viewed in coronal (Y-Z)

H) 10pcw model viewed in transverse (X-Y) view.

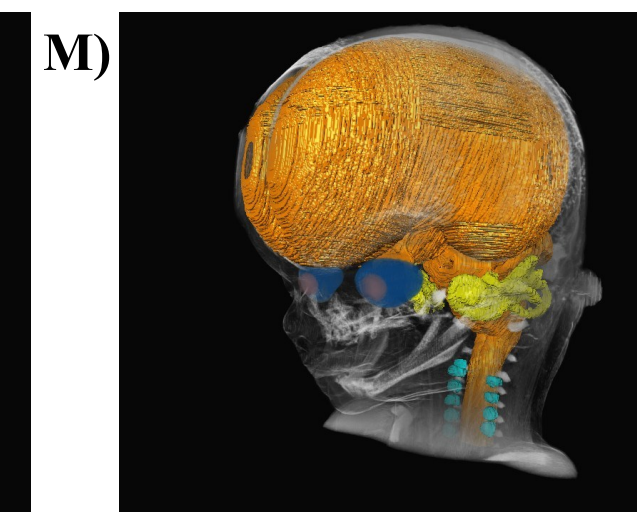
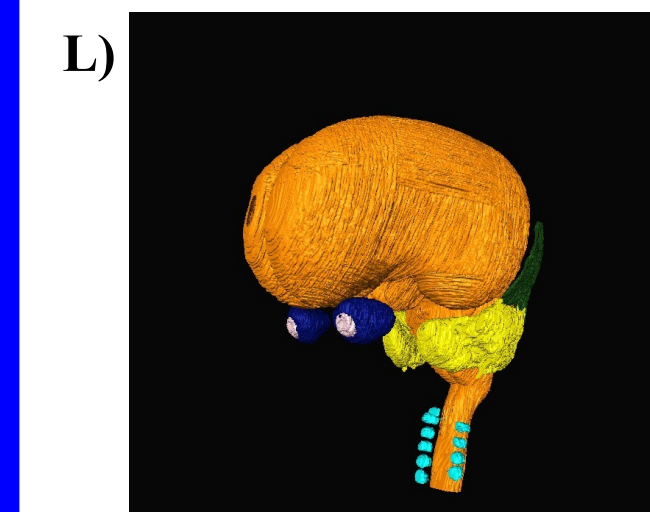
I) Painted domains of 10pcw model viewed as a 3D image

3- Viewing the defined domains in Amira

The domains defined in MAPaint can then be loaded individually into Amira. This allows for the creation of an accurate 3D representation of the foetal brain at this stage of development. By doing this it allows you to see the size of the various domains and what has developed within the foetal brain by this development time point.



Painted anatomy of the 8pcw model (head and body) viewed in Amira (J) and then in context within the remaining unpainted tissue shown in pale grey (K).



Painted anatomy of the 10pcw model (head only) viewed in Amira (L) and then in context within the remaining unpainted tissue shown in pale grey (M).

References

The HuDSeN project (www.hudsen.org)
Edinburgh Mouse Atlas Project (<http://www.emouseatlas.org>)
Amira (<http://www.fei.com/software/amira-3d-for-life-sciences/>)

Acknowledgements

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