MATURATIONAL CHANGES IN SUBCORTICAL STRUCTURES IN CHILDREN

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SEGMENTATION USING FSL FIRST

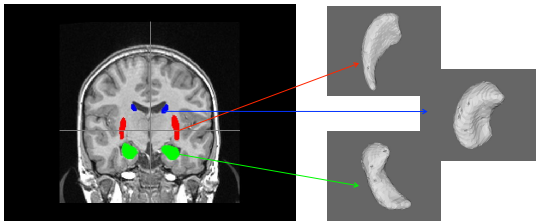
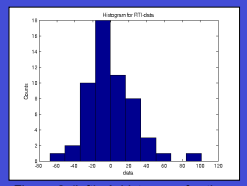


Figure 1: Left/right Hippocampus (green), left/right Caudatus (red) and left/right Putamen (blue) segmented using FSL FIRST.

In this project 55 MR-images are segmented using FSL FIRST. The data comes from 11 children in the age 8-14 years. In the program 17 subcortical structures are segmented for all the 55 scans. In this project the main focus is on 3 of the subcortical structures namely Hippocampus, Caudatus and Putamen. The children have been scanned 5 times each over a period of 2.5 years. The interesting part is the maturation of the structures.

The maturation is analysed using different methods e.g. Volume, surface area and local shape changes.

REACTION TIME



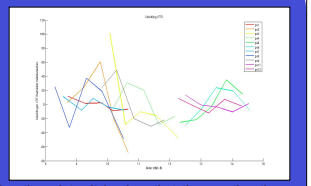


Figure 2 (left): A histogram for the reaction time data. It is clear that the reaction time decreases for each scan session.

Figure 2 (right): The development in the reaction time for each person.

At each scan session, a clinical test has been performed measuring the reaction time. It is expected that the reaction time decreases for each scan session.

The main hypothesis is to find a relation between the reaction time and development in one or more of the 3 subcortical structures.

Is it possible to find a relation and does it match the anatomical expectations?

ANALYSIS

Struktur	t-værdi
Højre Caudatus	-0.9505
Venstre Caudatus	-0.3874
Højre Putamen	-0.4903
Venstre Putamen	-0.3158
Højre Hippocampus	0.1223
Venstre Hippocampus	2.2091

Tabel 1: Tabel for udregnede t-værdier ved brug af GLM

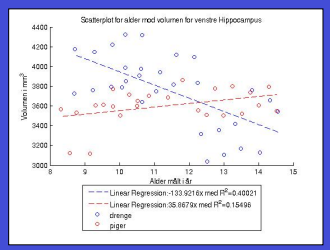


Figure 3: Scatterplot for the volume of the left Hippocampus against the age.

A lot of different statistical analysis have been performed and one of them is a general linear model (GLM). From the GLM, the t-values for the structures were calculated with respect to reaction time and age, and the left hippocampus showed a significant t-value.

VERTEX ANALYSIS

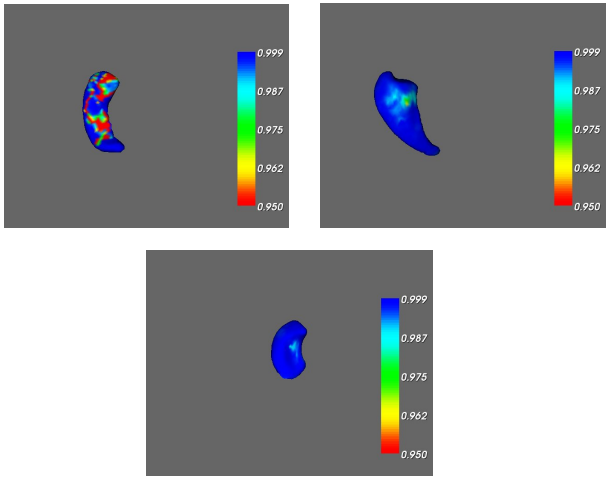


Figure 4: Some results from the performed vertex analysis with respect to the reaction time.
Left: Left Hippocampus. Right: Left Caudatus. Bottom: Left Putamen.

The vertex analysis is used to investigate the local shape changes with respect to the reaction time. In the analysis the difference between the mean structure (for all the scans) and the individual structures are calculated at each vertex. Some results are shown in figure 4.

The computation of the volume is one way of showing changes in the subcortical structures, whereas the vertex analysis is another useful one. In contrast the relationship between the surface area and the volume lines out whether the structure is circle-formed or not .

Shape – volume and surface area

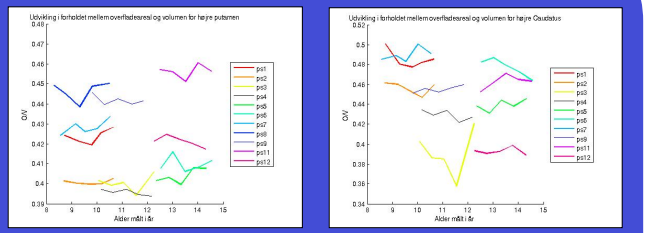


Figure 5: The plots show the development in the relationship between surface area and volume as a function of the age. Each graph represents each participating person. It is expected that the shapes are growing and the relationship will therefore be decreasing. Left: For the right Putamen. Right: For the right Caudatus. Person nummer 8 is here excluded because of the lacking quality of the segmentation. The right Caudatus is too small for all 5 scans for person nummer 8.

The relationship between the surface area and volume tells something about the shape. If the surface area is much bigger than the volume, it means that the shape is complex, like a star. A ball, on the other hand, has a bigger volume than the surface area.

In this case, the relationship is expected to decrease because of the growth of the structure over time. The tendency of the graphs are as expected.

CONCLUSION

So far there have been found a significant t-value for the left hippocampus with respect to age and volume.

Future work will be to look at the local shape changes and compare them to the anatomical and neurological knowledge of each structure.