The Impact of Manual Correction on Automated Hippocampal Volumetry in a Young Athletic Cohort with Variable Level of Exposure to Head Trauma

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[**Introduction**]

An estimated 1.6 to 3.8 million people suffer from sport-related concussion annually, yet the long-term effects of concussion and repetitive head injury exposure are not fully understood. Given the potential risk of future neurodegeneration, the hippocampus has emerged as a key region of interest. While post-mortem studies demonstrated marked hippocampal atrophy in athletes from high-impact sports, more recent in-vivo research reveals more nuanced findings as they rely heavily on imaging and segmentation accuracy. Freesurfer, a widely used tool for automated hippocampal segmentation, has been shown to overestimate the volume, especially in older populations. In this study, we evaluated the accuracy of Freesurfer's segmentation against manual refinement in a cohort with head impact exposure.

[**Method**]

Structural MRI data (T1W and T2W) of the CARE-SALTOS Integrated (CSI) project was used for hippocampal segmentation using FreeSurfer (7.4.1). Twenty participants (age range: 29 to 32) were sex-matched and grouped into high-exposure (n=10, including 5 football players) and low-exposure cohorts (n=10). The hippocampal volumes were compared between initial automatic segmentations and subsequent manually refined delineations by a trained medical professional using paired t-tests.

[**Results**]

Our results showed significant differences in the hippocampal volume between automatic segmentation and after manual refinement. By visual inspection, FreeSurfer tends to overestimate hippocampal segmentation volumes as generated masks extend into lateral ventricular spaces and include choroid plexus. In both groups, hippocampal volumes significantly decreased after manual refinement (Left Hippocampus, -788.81±245.30mm^3, p=1.15E-11; Right Hippocampus, -649.60±246.83mm^3, p=3.59E-10).

[**Conclusion**]

Based on our results, we conclude that while automatic segmentation is a feasible and fast method for large datasets, it requires subsequent manual refining to ensure data accuracy by avoiding volumetric overestimation and potential bias from adjacent ventricular areas.