Changes in glymphatic function after mild traumatic brain injury: one and three-month assessments

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OBJECTIVE

- Mild traumatic brain injury (mTBI) may alter glymphatic function, but its progression and variability remain obscure.
- To examine glymphatic function following mTBI within one month and after three-month post-injury.
- To determine whether variations in glymphatic function are associated with differences in post-traumatic symptoms.

METHODS 1

Participants

- 39 individuals (47.21±14.88 years) with mTBI
- Age-matched 35 healthy individuals (44.62±13.12 years)

Brain imaging

- Individuals with mTBI underwent MRI scans at two time points, using a 3-T Magnetom Trio scanner.
- For controls, MRI scans were obtained for comparison.
- Structural T1-weighted images, diffusion tensor imaging (30D), and susceptibility weighted imaging were obtained.

Image analysis
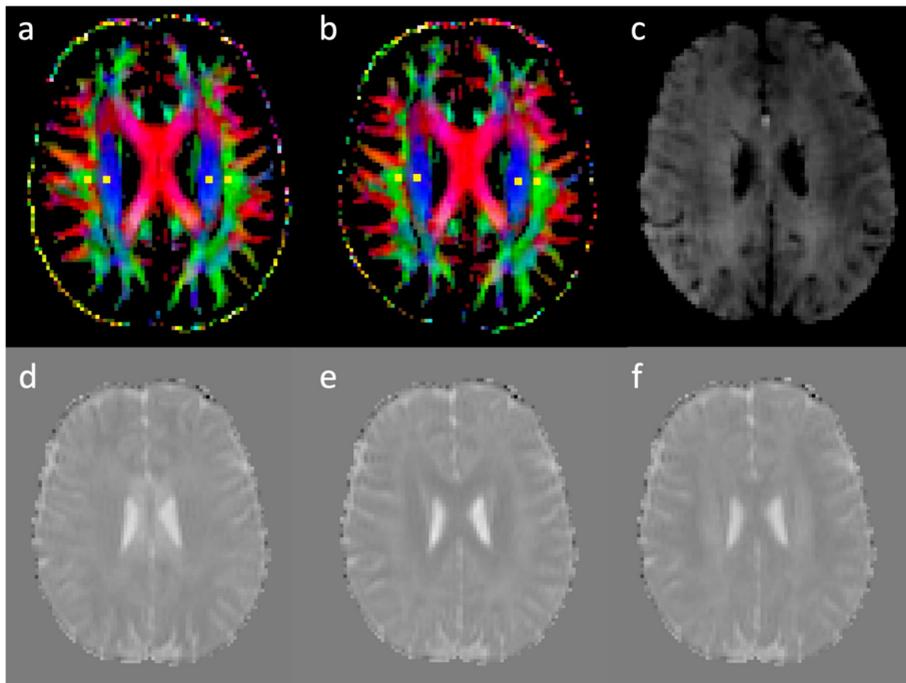
▲ An example of ROI definition for one participant in the DTI-ALPS. (a) Four ROIs (colored yellow) were drawn on the color-coded fractional anisotropy map at the level of the lateral ventricular body, targeting the projection and association fibers at the initial assessment, and (b) at the follow-up assessment. (c) An axial SWI slice at the same level, along with (d) x-, (e) y-, and (f) z-axis diffusivity maps.

- Two square ROIs (left hemisphere), each measuring 4 voxels (with 3.8 mm sides), were manually created on the left projection and association fibers.

$$ALPS\ index = \frac{mean(D_{xproj}, D_{xassoc})}{mean(D_{yproj}, D_{zassoc})}$$

METHODS 2

- The age- and sex- adjusted ALPS index was compared using the Wilcoxon rank-sum test and Wilcoxon signed-rank test.
- Using a linear mixed-effects model, residual values were generated by regressing the ALPS index on age, sex, and time point (0 or 1).
- The patients group was divided into good (n=20) and poor (n=19) prognosis subgroups (median changes in the $ALPS_{T1} - ALPS_{T0}$).

RESULTS

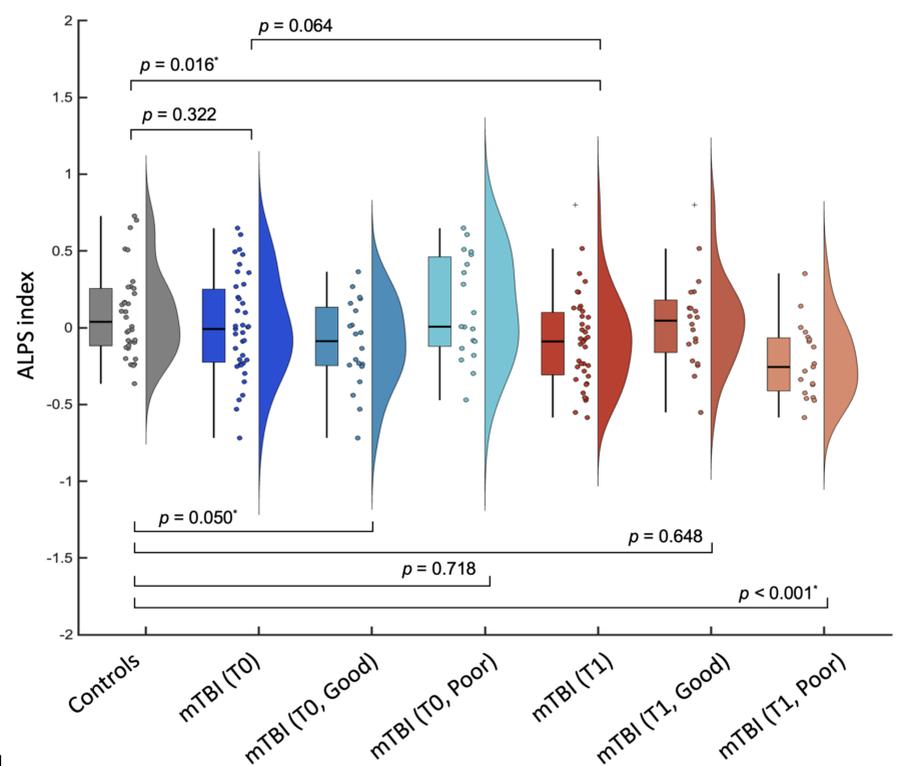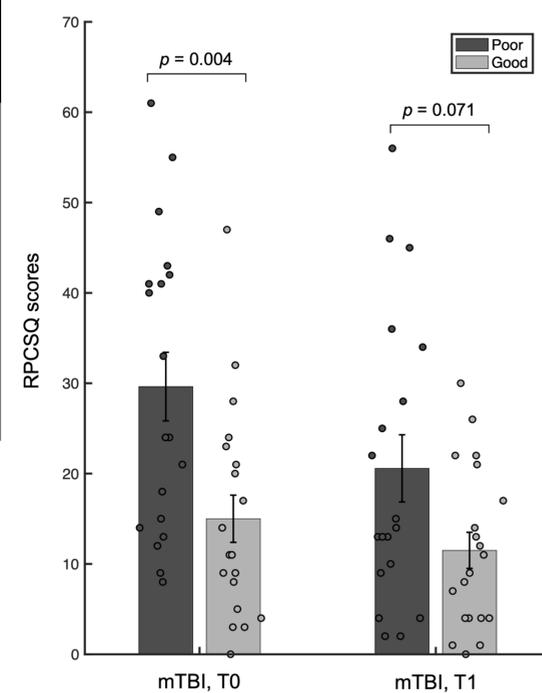
▲ Comparing mean ALPS index among controls and individuals with mTBI at initial and follow-up assessments.

◄ Bar graph comparing the overall Rivermead post-concussion symptoms questionnaire scores (RPCSQ) between the good and poor prognosis at initial and follow-up assessments, respectively.

CONCLUSION

◆ Variability in the ALPS index and glymphatic dysfunction may underlie persistent post-traumatic symptoms in mTBI, suggesting a potential role as a prognostic biomarker.