

Traumatic Brain Injury-Like Pathology in Muskoxen

Implications for Natural Occurrences of TBI

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INTRODUCTION

A better understanding of traumatic brain injury (TBI) in animals with extreme adaptations will provide insight to develop strategies for the reduction of TBI in humans. Muskoxen (*Ovibos moschatus*) are large tundra-dwelling bovids that can strike heads at ± 50 km/h during the rut. **Do their helmet-like horns protect muskoxen against brain injury?** Our research explores brain and skull anatomy of combative bovids, focusing on whether these animals sustain TBI after head-butting, and if not, what features most likely provide protection.



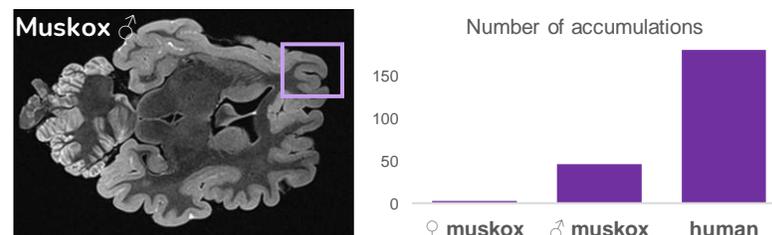
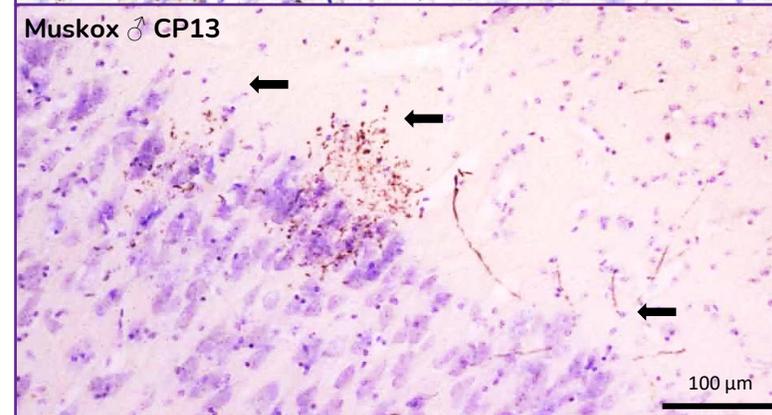
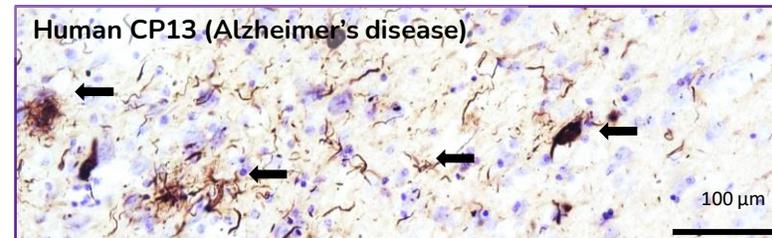
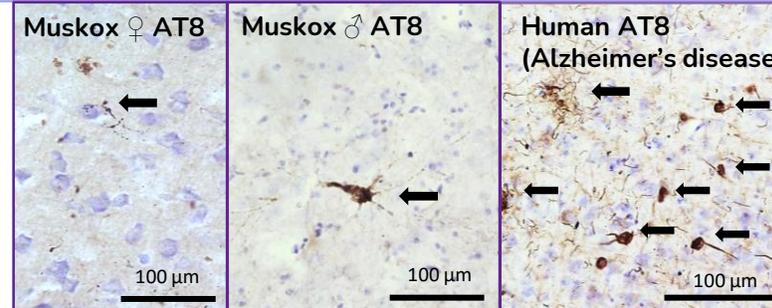
METHODS

Subjects:

- 1 muskox ♂ brain (observed headbutting)
- 1 muskox ♀ brain (no headbutting, negative control)
- 1 human brain, advanced Alzheimer's disease (positive control)

Techniques:

- 7T MRI scans of the muskox brains (Magnetom, Siemens)
- Immunohistochemistry staining of the prefrontal cortex with **CP13** (1:1000, Ser 202), and **AT8** (1:1000, Ser 202/Thr305) antibodies that highlight phosphorylated tau protein, a biomarker for neurodegenerative lesions, to detect any chronic or acute brain trauma related to head-butting.



RESULTS & DISCUSSION

- No macroscopic signs of TBI, but the male muskox showed multiple microscopic taupathies resembling early chronic traumatic encephalopathy (CTE)
- The female muskox showed only sparse microscopic damage, possibly linking head-butting to TBI
- Preliminary findings (n=2) indicate **muskoxen may suffer from chronic or acute brain trauma after head-butting despite protective headgear**
- Consequences for sexual selection and evolutionary strategies
- Potential model for human TBI and CTE

CONTINUING RESEARCH

- Increase sample size
- Additional species: Bighorn and domestic sheep, whales (in progress)
- Additional biomarkers for glial and microglial morphology, inflammation, vascular damage, and additional tau sites.

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