WRIISC
War Related Illness & Injury Study Center

VA
U.S. Department of Veterans Affairs
Veterans Health Administration
Office of Public Health

Advanced Neuroimaging: Women with TBI

Maheen M. Adamson, PhD
Director Research & PhD Fellowships, WRIISC CA

Presented by the **VA War Related Illness and Injury Study Center (WRIISC)**

WRIISC: Current Investigations

Examine the health outcomes of patients with TBI and PTSD via interviews and standardized screening measures

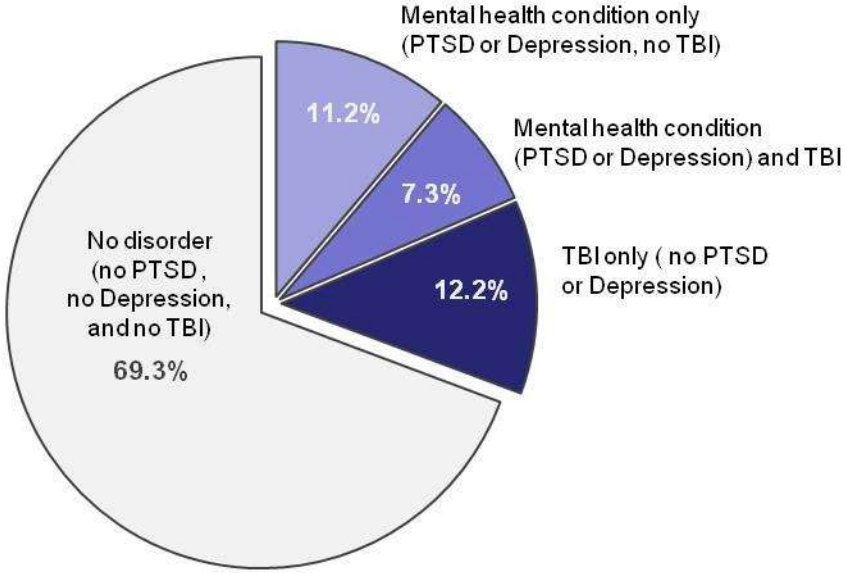
Use DTI fiber tractography during weekly clinical case meetings to evaluate brain integrity in our patient population

Investigate the relationships among DTI data, TBI and PTSD diagnoses, and neuropsychological measures

Goal: To inform clinical practice with research knowledge

TBI: Causes and Consequences

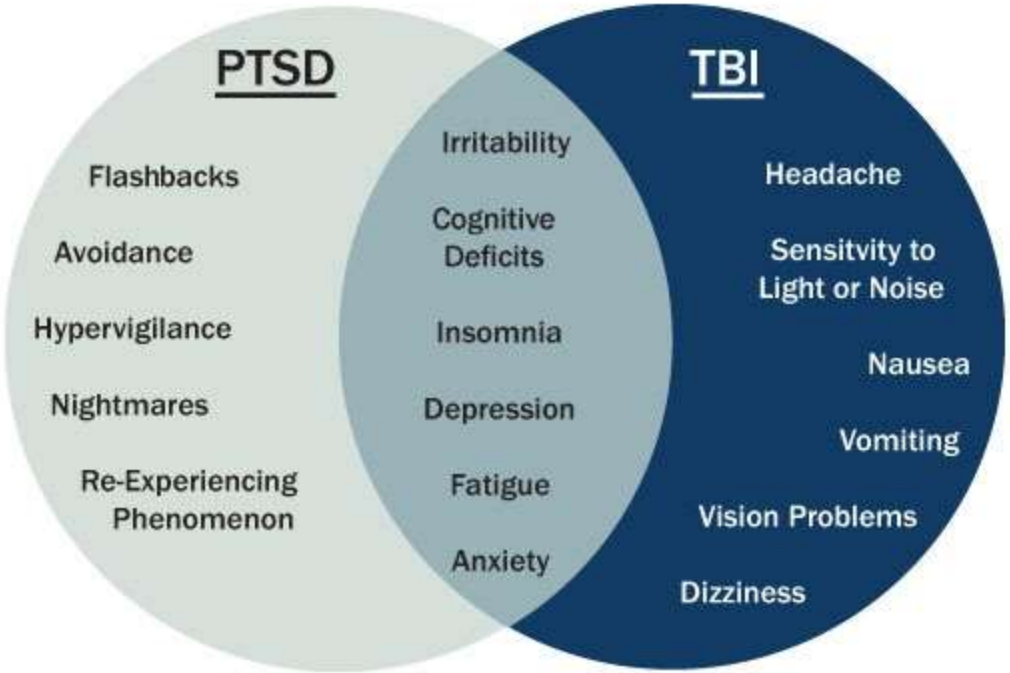
- A “signature” injury of OEF and OIF campaigns.
- As many as 30% of returning soldiers afflicted.
- Often co morbid with posttraumatic stress disorder.



Source: Rand Corporation

TBI: Causes and Consequences

- TBI and PTSD share similar symptoms.



"Co-occurring PTSD and mTBI unfortunately has emerged as a common problem for many service members and veterans in recent years.

Since PTSD and mTBI affect one another, it is imperative that clinicians treat them concurrently , and do so within a multidisciplinary context."

-Matthew J. Friedman MD, PhD
National Center for PTSD

Gender Differences

- Dr. Odette Harris's work suggests that there are gender differences in the outcomes for Veterans with TBI because women in the military face unique gender-related stressors
- Because women account for only 5% of TBI injuries in the military these unique problems generally go unnoticed
- How can our current research endeavors at the VAPAHCS help?

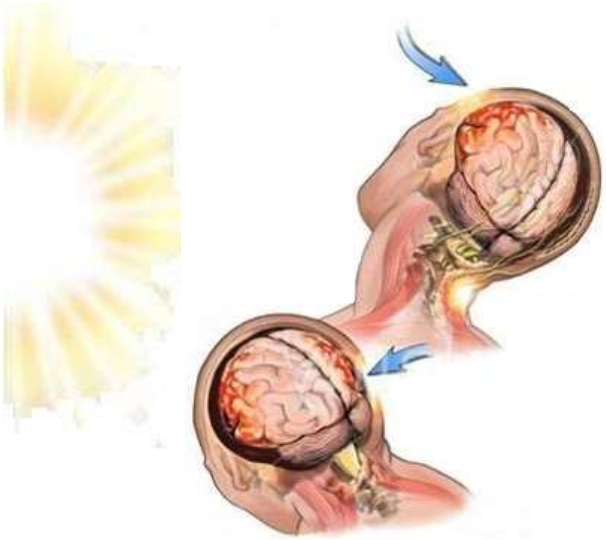
ADVANCED NEUROIMAGING FOR TBI AT THE VA

DETECTION, MANAGEMENT & TREATMENT OF MILD AND MODERATE TBI

Presented by the **VA War Related Illness and Injury Study Center (WRIISC)**

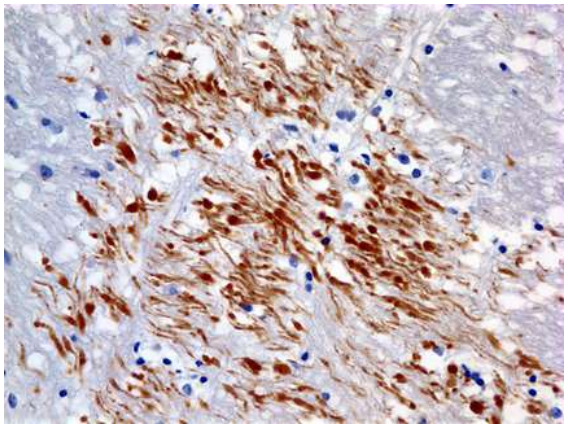
TBI: Causes and Consequences

- Rotational forces result in brain contusions.
- Blast waves shear and distort neural tracts.
- Biochemical changes result in diffuse axonal injury (DAI).



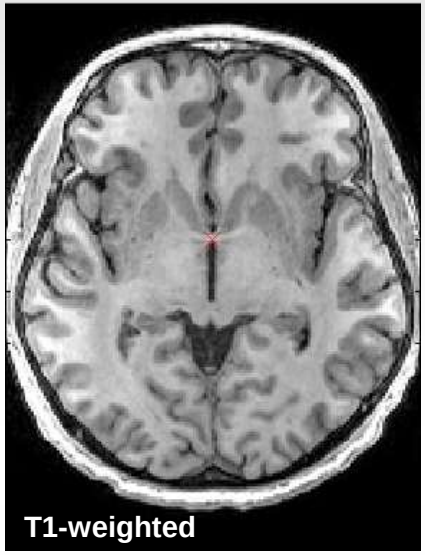
Coup-contracoup and blast wave injury

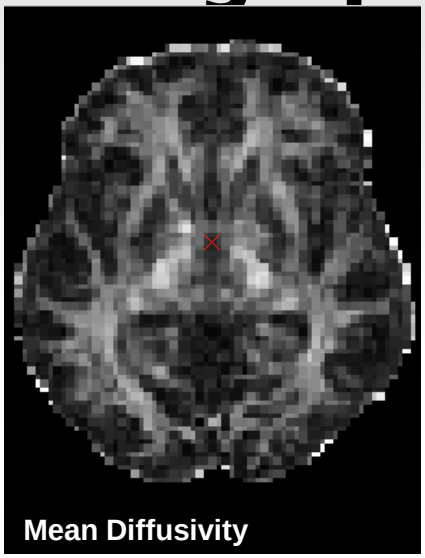
DAI

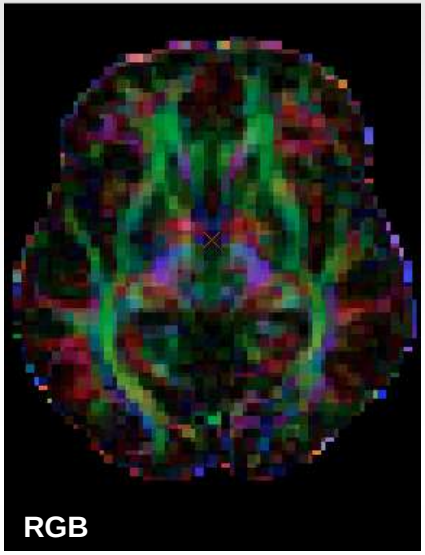


Axonal swellings in DAI

Diffusion Tensor Imaging (DTI) Tractography

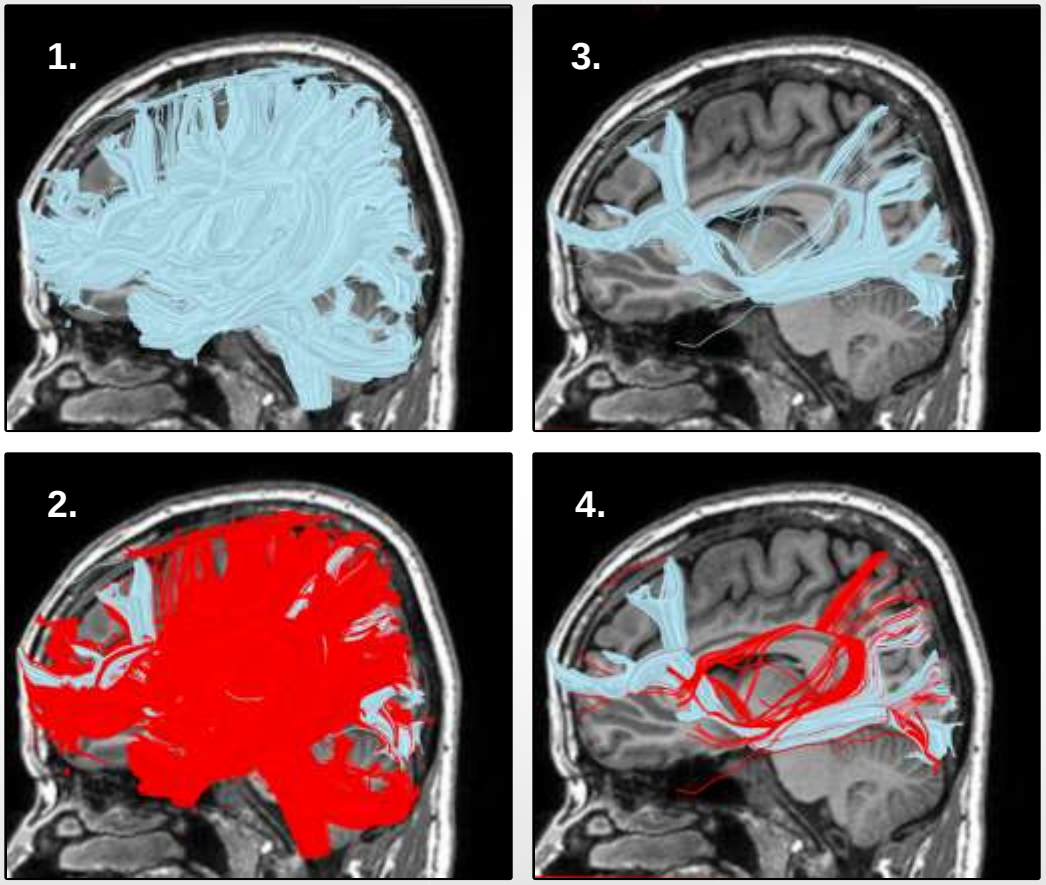


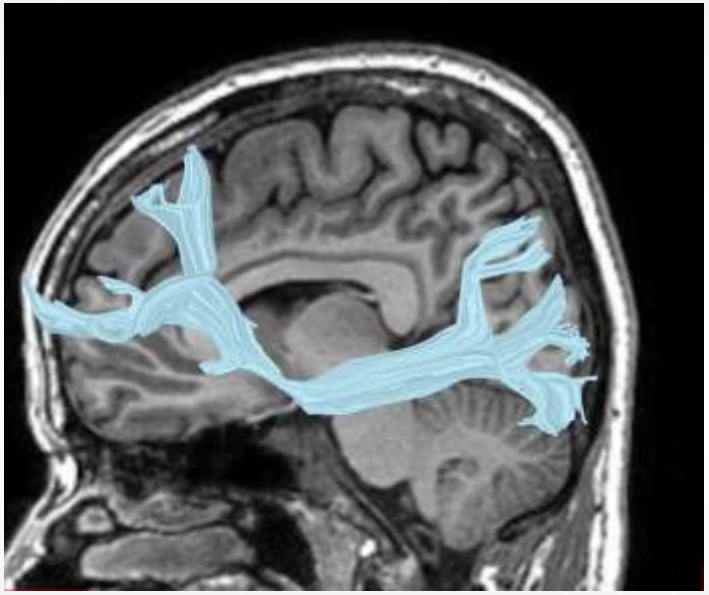




- All done at the VA Palo Alto 3T GE MRI scanner
- DTI: Diffusion weighting was applied along noncollinear 30 directions, *b*-value of 1000 s/mm^2, 5 *b* = 0 volumes. Voxel dimensions were 2.5 × 2.5 × 2.5 mm.
- Structural: T1-weighted images were acquired by using three-dimensional spoiled-gradient recalled acquisition (3D –SPGR).

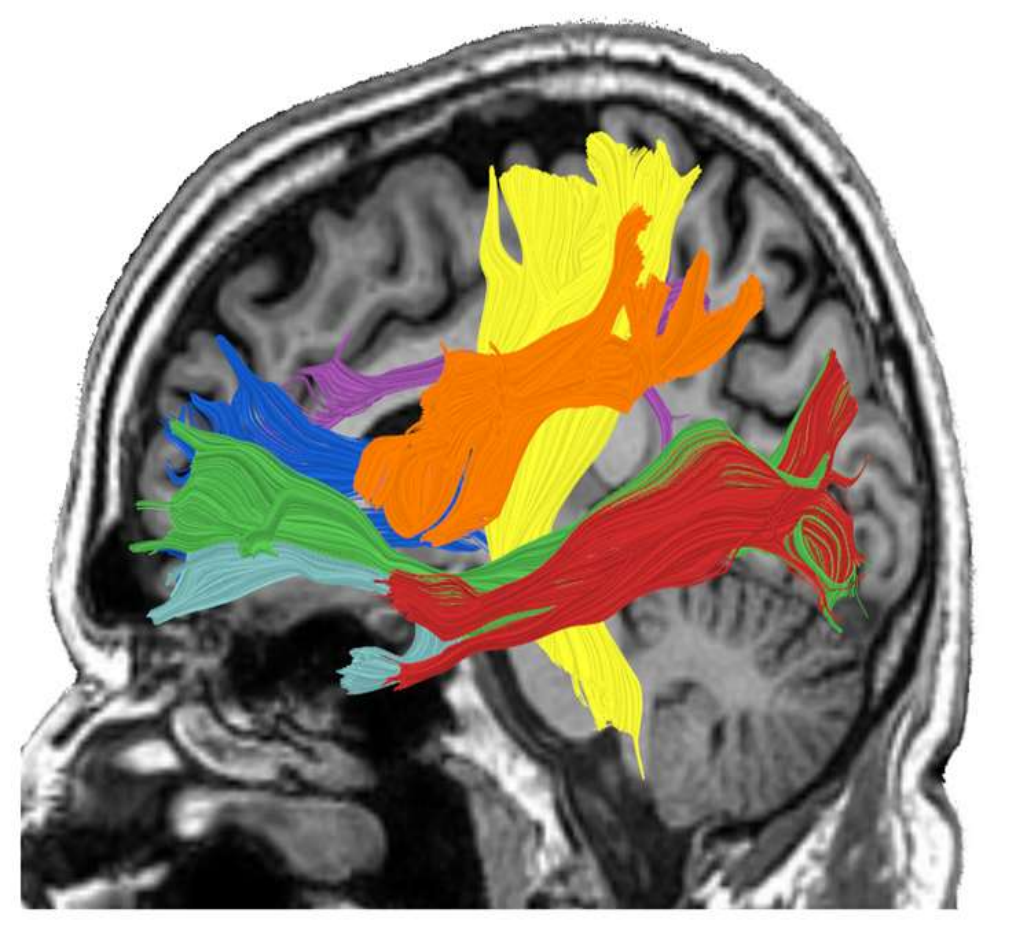
DTI Tractography





Inferior Frontal Fasciculus

Diffusion Tensor Imaging (DTI)



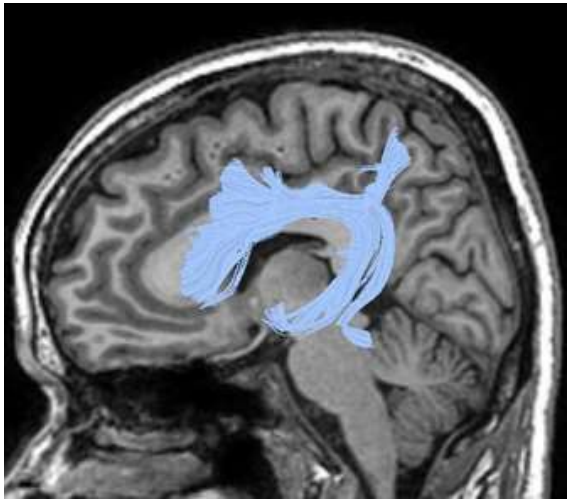
- InferiorLongitudinal (RIL/LIL)
- AnteriorThalamic (RAT/LAT)
- Cingulum (RCG/LCG)
- Uncinate (RUN/LUN)
- CorticalSpinal (RCS/LCS)
- SuperiorLongitudinal (RSL/LSL)
- InferiorFrontalOccipital (RIF/LIF)

General Cognitive Abilities Results

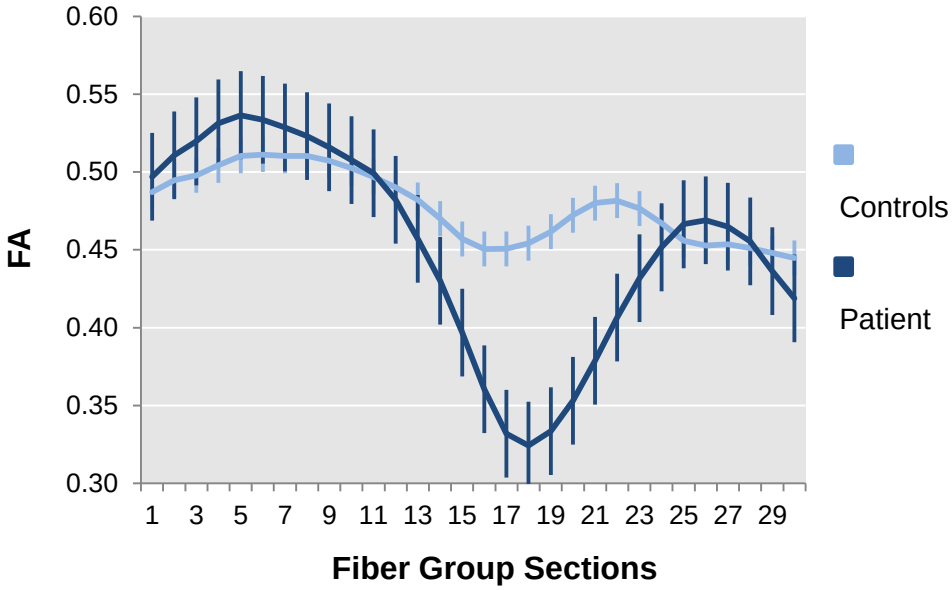
	N	AGE (*M* ± *SD*)	MALES *N*	EDU (YRS) (*M* ± *SD*)	LEFT HANDED	DIGIT SPAN (*M* ± *SD*)	CVLTII (*M* ± *SD*)	TRAIL MAKING B (*M* ± *SD*)
CONTROL	16	46.4 ± 13.3	15	15.5 ± 2.7	1	24.4 ± 2.9	48.4 ± 7.3	59.3 ± 18.8
PTSD	17	49.1 ± 9.3	14	12.8 ± 3.0	0	23.8 ± 4.4	39.7 ± 5.9	84 ± 27.3
TBI+PTSD	47	46.0 ± 11.5	39	14.2 ± 2.5	4	25.7 ± 6.0	41.8 ± 8.8	89.7 ± 60.8

Superior Longitudinal Fasiculus

Left Superior Longitudinal Fasciculus

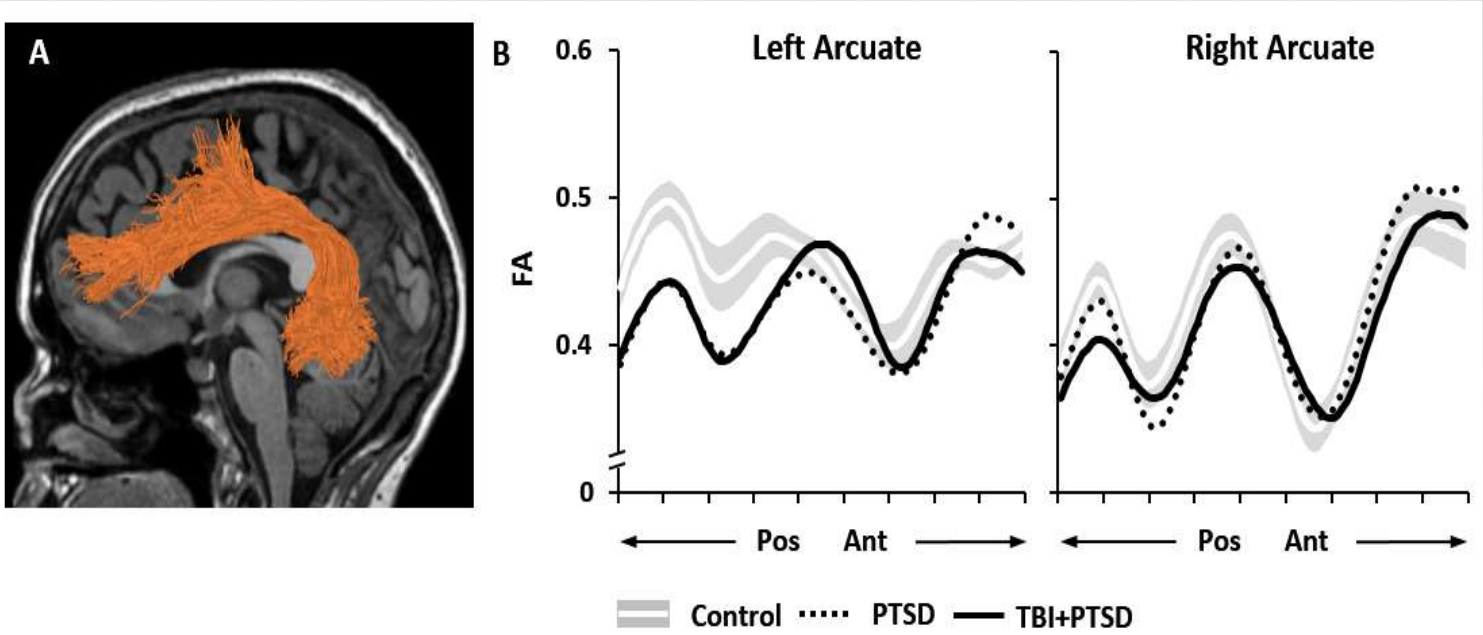


Left SLF: FA Values across whole fiber group



- Fiber groups are divided into 30 sections. FA (fractional anisotropy) values were extracted from each section.
- Abnormally low FA values indicate damaged pathways.

Arcuate Fasciculus



A: Sagittal view of one patient's left hemisphere. The arcuate fasciculus is in orange

B: Tract profiles for the left and right arcuate. The x-axis consists tract sections (90) ordered consecutively from the most posterior to anterior. The y-axis depicts raw FA (fractional anisotropy) values. Control, PTSD, and TBI+PTSD profiles are represented.

Recent Findings

- Patients with PTSD and TBI+PTSD have compromised fiber tracts compared to healthy controls, both in an aggregate measure of 20 tracts and in specific measures of the superior longitudinal and arcuate fasciculus.
- We did not find differences in FA scores between the PTSD and TBI+PTSD groups.

Adamson et al (*in press*)

Sample Size For Women Participant

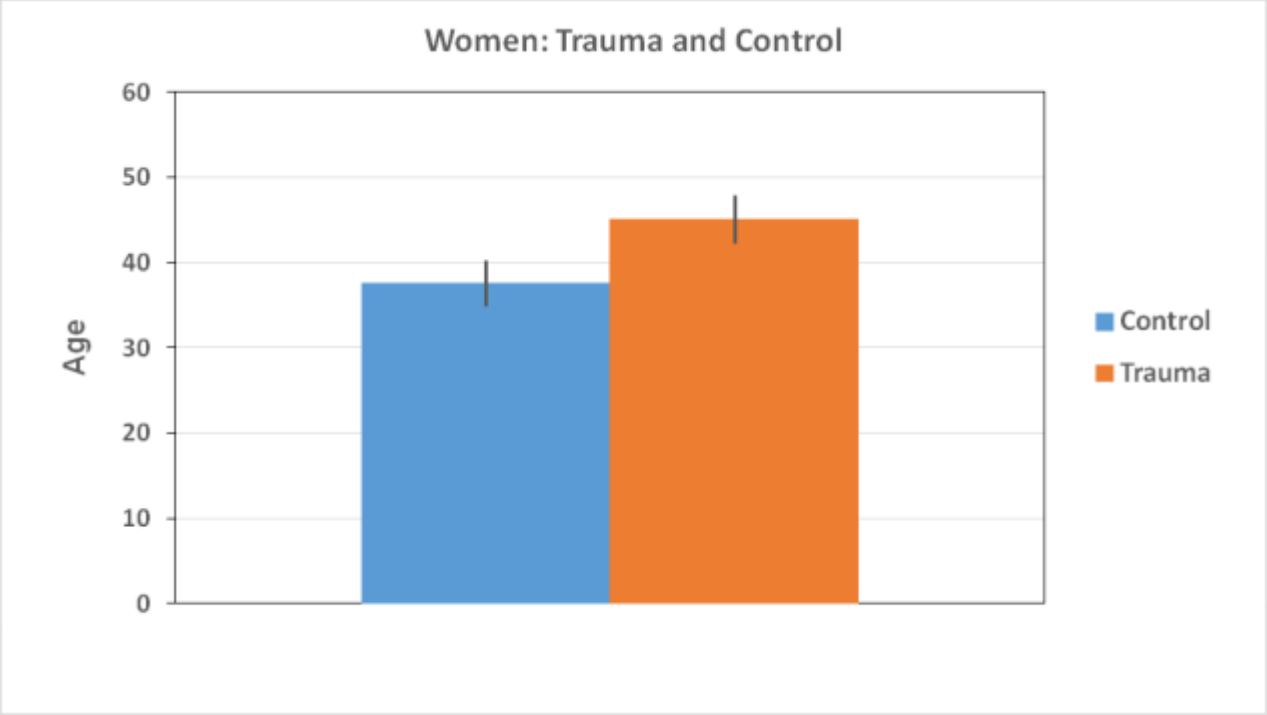
Total *n* = 91 Veterans

Women Control		
N	Age	Education
9	**38**	**19**
Std dev	**8.03**	**2.78**
Std err	**2.68**	**0.93**
Men TBI/PTSD		
N	Age	Education
11	**45**	**13**
Std dev	**8.95**	**1.49**
Std err	**2.70**	**0.45**
Women TBI/PTSD		
N	Age	Education
11	**45**	**15**
Std dev	**9.27**	**3.94**
Std err	**2.79**	**1.25**

Gender Difference in PTSD

PCL scores are greater in men trauma participants (64) than women trauma participants (45): t(15) = -2.81, *p* = 0.01

Trauma in Women: Age Representation



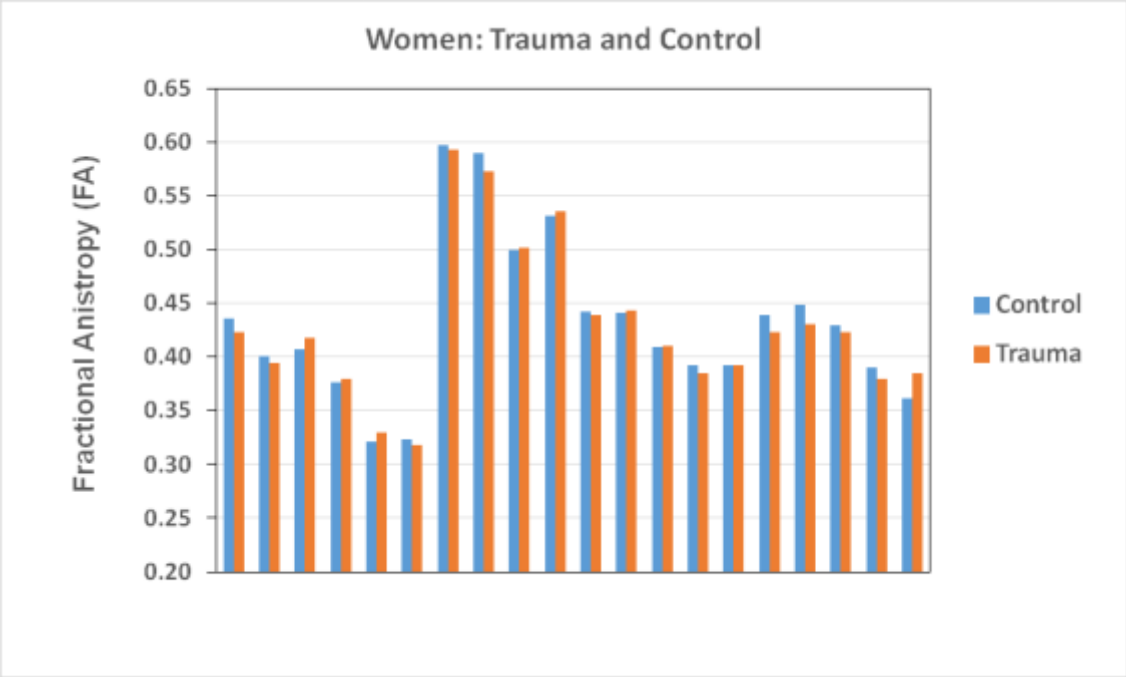
Age is not significantly different between women with trauma (45) and women who were control (37) participants: t(17) = -1.91, *p* = 0.071

Women with Trauma vs. Women Control Participants

- Women control participants have significantly more education (19 yrs) than women trauma participants (14 yrs): $t(16) = 2.70$, $p = 0.015$
- PCL scores are not significantly different between women trauma participants (45) and women controls (34): $t(11) = -1.31$, $p = 0.21$

Biggest Problem:
Number of subjects is too small

Trauma differences in fiber integrity for women



FA scores from DTI fiber tracts were not significantly different between women trauma and women control participants

Current Efforts

- Recruitment, Recruitment & Recruitment for Women Veterans in our studies, e.g.:
  - Repetitive Transcranial Magnetic Stimulation for:
    - Chronic Pain in Gulf War Veterans (PI: Ashford)
    - Improvement of Cognitive Function in TBI (PI: Adamson)
    - Treatment-resistant Depression in Veterans (CSP 556; PI: Dr. Yesavage)

For More Information

- rTMS Study Team direct phone line
  - 650-852-3233
- WRIISC Website
  - www.warrelatedillness.va.gov
  - Click on “Research”
- www.ClinicalTrials.gov
  - Search on “GW1 rTMS”

WRIISC RESEARCH COLLABORATIONS

Mount Sinai School of Medicine
New Jersey Medical School
New York University
Stanford University
Johns Hopkins Medical School
Georgetown University
UC Berkeley
Harvard Medical School
University of Wisconsin

The WRIISC TEAM

Stanford Faculty, VA Research, Radiology, OI&T & our VA specialty care providers