



NeuroProof AI Clinical Brief

Clinical Brief: NeuroProof AI™

Blockchain-Secured, Explainable Intelligence for Medical Diagnostics

Developed from peer-reviewed research on Vision-Language and Reasoning LLMs for mild TBI diagnosis and clinical decision support.

1. Overview

NeuroProof AI™ represents a new class of *explainable medical AI*, combining fine-tuned **Vision-Language Models (VLMs)** with an advanced **Reasoning Large Language Model (LLM)** to deliver **transparent, auditable, and verifiable diagnostic insights**.

Built upon collaborative research between **Old Dominion University, BRAINBox Solutions,** and the **U.S. Army Medical Research Team**, the system demonstrates how multimodal AI and blockchain verification can overcome the limitations of black-box diagnostic systems.

2. Clinical Problem

Accurate diagnosis of **mild Traumatic Brain Injury (TBI)** remains one of the most difficult challenges in clinical medicine:

- Symptoms are **subtle and variable** across patients.
- **MRI interpretations** require expert review and are time-consuming.
- Traditional AI systems lack **explainability and auditability**, raising regulatory and ethical barriers to adoption.

These challenges create an urgent need for a system that not only increases diagnostic accuracy but also **provides transparent, reasoning-based evidence** for each clinical decision.



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3. Research Foundation

Peer-Reviewed Source Studies:

1. **Proof-of-TBI: Fine-Tuned Vision-Language Model Consortium Integrated with OpenAI-o3 Reasoning LLM for TBI Prediction** (Bandara et al., 2025).
2. **Medical Diagnosis Support System for Mild TBI Prediction** (Shetty et al., 2025).

Key Innovations Documented:

- Integration of **multiple fine-tuned Vision-Language Models (VLMs)** (Llama-Vision, Pixtral, Qwen2-VL) trained on labeled MRI datasets.
- Use of **OpenAI-o3 reasoning LLM** to synthesize and validate predictions across the model consortium.
- A **consensus-based diagnostic mechanism**, where final decisions are reached through logical evaluation rather than single-model inference.
- Implementation of **blockchain-backed provenance** and **smart contract governance** to ensure data integrity, transparency, and compliance.

4. System Architecture

Layer	Functionality	Clinical Impact
Data Lake Layer	Stores, anonymizes, and preprocesses MRI and EMG data.	Enables scalable and secure dataset management.
Vision-Language Model Layer	Fine-tuned VLMs interpret clinical images and textual annotations.	Improves detection of subtle TBI indicators.
Reasoning LLM Layer	OpenAI-o3 synthesizes multi-model predictions into a single reasoned diagnosis.	Produces explainable, consensus-based results.
Blockchain Provenance Layer	Verifies model interactions, data lineage, and output integrity.	Creates auditable and regulatory-compliant evidence.



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5. Clinical Evaluation

Study Parameters

- Conducted in collaboration with the **U.S. Army Medical Research Team** (Newport News, VA).
- Dataset: Labeled MRI scans with expert annotations of mild TBI symptoms.
- Models: Llama-Vision, Pixtral, and Qwen2-VL fine-tuned using **QLoRA** for efficient deployment on consumer-grade hardware.

Findings

- Fine-tuned VLMs achieved **significant improvements in accuracy** compared to baseline image classification models (e.g., ResNet50).
- The reasoning LLM (OpenAI-o3) produced **consistent consensus diagnoses**, improving reliability, and reducing bias.
- **Training-validation loss curves** confirmed stable convergence and high reproducibility.
- Blockchain provenance ensures **traceability of every diagnosis**, enabling future audit and research replication.

6. Clinical Use Cases

Specialty	Application	Outcome
Neurology	MRI-based mild TBI detection and classification.	Early, explainable diagnosis and improved patient management.
Rehabilitation Medicine	Reflex analysis and cognitive recovery tracking.	Objective performance-based metrics for therapy planning.
Sports Medicine	Concussion and fatigue monitoring.	Real-time evaluation for return-to-play protocols.
Military & Defense Health	Field diagnostics for head trauma and cognitive readiness.	Portable, edge-deployable decision support.



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Insurance & Regulatory Review	Diagnostic verification via blockchain audit trail.	Reduced dispute rates and improved compliance.
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7. Comparative Clinical Advantage

Capability	NeuroProof AI	Conventional AI
Explainable Reasoning	✔ Transparent, traceable	✘ Opaque / black-box
Multi-Model Consensus	✔ Ensemble-based reasoning	⚠ Single-model inference
Blockchain Provenance	✔ Immutable verification	✘ No traceability
Clinical Integration	✔ HIPAA & FDA-aligned	⚠ Limited regulatory design
Deployment Flexibility	✔ Cloud / Edge / On-prem	⚠ Restricted environments

8. Regulatory & Ethical Alignment

- **HIPAA & FDA 510(k) Preparedness:** Designed for data security and clinical audit compliance.
- **Ethical AI Design:** Transparent logic chains for clinician review.
- **Blockchain Governance:** Tamper-proof, decentralized verification of diagnostic records.
- **Explainable AI (XAI) Framework:** Satisfies emerging EU and U.S. regulatory standards for medical AI transparency.

9. Future Development Roadmap

- Expansion to **multi-modality diagnostics** (EEG, CT, EMG, ultrasound).



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- Integration with **FHIR-compliant EHR systems**.
- Longitudinal tracking of **post-injury recovery and outcomes**.
- AI model accreditation via **federated learning and medical device certification**.

10. Clinical Impact Summary

NeuroProof AI represents a paradigm shift in medical diagnostics:

“From probabilistic AI predictions to verifiable, reasoning-based clinical intelligence.”

By combining **Vision-Language understanding**, **large-model reasoning**, and **blockchain-backed trust**, NeuroProof AI delivers a solution that is:

- Clinically actionable
- Ethically transparent
- Technically secure
- Ready for real-world deployment

Contact & Collaboration

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