Informed Consent Document

Dear Research Participant,

You are invited to participate in a clinical study investigating the efficacy of Mirror Neuron System-based Virtual Reality technology for upper limb rehabilitation in stroke patients. This research is conducted by the General Hospital of Ningxia Medical University, with funding from the Key Research and Development Program of Ningxia Hui Autonomous Region (Project No. 2022BEG02047).This document details the study's purpose, procedures, and potential risks/benefits. We encourage you to discuss this information with trusted individuals and consult our research team regarding any questions. Before deciding on participation, please read all sections carefully. Study investigators will provide comprehensive explanations to support your informed decision-making.

Research Rationale

Stroke carries a high global disability burden, with epidemiological studies indicating that 80% of survivors worldwide experience varying degrees of motor impairment. Notably, over 50% retain upper limb dysfunction beyond six months post-onset, significantly compromising activities of daily living. Mirror neurons—dual-function neural substrates processing both motor execution and sensory perception—underlie promising rehabilitation approaches. While mirror neuron-based therapies demonstrate efficacy in post-stroke motor recovery, substantial knowledge gaps persist regarding integrated sensorimotor training protocols. Specifically, evidence remains inconclusive on whether sequential activation of sensory and motor mirror neuron circuits enhances functional outcomes (Hypothesis 1). Current mirror therapy also demands absolute environmental quietude and sustained attention, limiting practical implementation.

This study introduces an innovative sensorimotor integration protocol combining graded motor imagery (GMI) with somatosensory observation training (SOT). We hypothesize that synchronized sensorimotor neural engagement will optimize cortical reorganization (Hypothesis 1). Furthermore, we propose that immersive virtual reality (VR) delivery will overcome traditional limitations by enhancing engagement through multi-sensory immersion, enabling group-based training while reducing attentional demands (Hypothesis 2). Through randomized controlled trials and neurophysiological assessments (rs-fMRI), this research will: (1) Validate clinical efficacy via scales; (2) Elucidate neural mechanisms underlying recovery; (3) Establish a resource-efficient protocol accessible to patients across functional ability spectra, irrespective of baseline motor severity.

Eligibility Criteria

This study operates under the principles of voluntary participation and autonomous decision-making. We aim to recruit 60 qualified participants consecutively from the Department of Rehabilitation Medicine at General Hospital of Ningxia Medical University. The inclusion criteria are as follows:

1. Age 18-80 years; patients willing to accept treatment in this study and sign an informed consent form;
2. Patients with unilateral hemiplegia due to ischemic or hemorrhagic cerebrovascular diseases

confirmed by brain Computed Tomography or Magnetic Resonance Imaging scans that meet the classification and diagnostic criteria for cerebrovascular diseases;

3. First stroke and the onset time of the first stroke within 6 months;

4. Mini-Mental State Examination (MMSE) score ⩾ 20 points;

5. Modified Ashworth Scale (upper limb and hand) ⩽ grade 2.

Exclusion Criteria

Individuals meeting any of the following criteria will be excluded from study participation:

1. cognitive dysfunction (MMSE ≤ 20 points) ;

2. neglect symptoms or visual impairment;

3. a history of substance abuse or alcoholism;

4. severe speech, attention, auditory, visual, intellectual, or mental disorders;

5. Bilateral upper limb dysfunction caused by orthopedic or neurological reasons;

6. Complications of epilepsy or significant organ (heart, lung, liver, kidney, etc.) failure, malignant tumors, or other unstable conditions;

7. Presence of metallic foreign bodies in the body, suffering from claustrophobia, or other MRI-related contraindications.

Study Procedures for Participants

Prior to enrollment, our research team will conduct a comprehensive health screening to document your medical history and current health status. If deemed eligible, you will receive detailed study information to freely decide on participation. Written informed consent must be obtained before initiating any research procedures.

Participant Procedures

Upon voluntary enrollment, your participation will involve:

1.Baseline Assessment: comprehensive evaluation using Fugl-Meyer Assessment Upper Extremity (FMA-UE),Action Research Arm Test(ARAT),Modified Barthel Index (MBI),and rs-fMRI.All non-invasive procedures with minimal risk.

2.Randomized Allocation: assignment to one of four intervention groups,

1)GMI

2)Somatosensory Observation Therapy (SOT) + GMI:GMI protocol with integrated sensory observation videos

3）VR-GMI:HMD-guided GMI identical to conventional protocol.

4)VR-SOT/GMI:Combined sensorimotor training via VR immersion.

All groups: 20 min/session, 5 sessions/week for 4 weeks

3.Progress Monitoring: Standardized reassessments at:pre-intervention,mid-intervention (Week and post-intervention (Week 4)

4.Protocol Adherence Requirement:

1)Strict attendance at ⩾90% scheduled sessions.

2)Mandatory rescheduling for missed sessions within 48hrs.

3)Non-compliance exceeding 2 consecutive sessions withdrawal.

5.Note: Daily living habits remain unaffected throughout the study.

Adverse Event Prevention and Management

Rigorous safeguards are implemented to mitigate potential risks associated with this study. While immersive VR technology carries theoretical risks including transient dizziness, eye strain during extended visualization, musculoskeletal discomfort from maintained postures, and rare collision/fall hazards,no serious adverse events have been reported in peer-reviewed literature for mirror therapy or VR rehabilitation protocols. Prevention strategies include:

1)Cybersickness Mitigation:

- Progressive exposure protocol (5-15-20min gradient)
- Ambient airflow ventilation
- Anti-motion sickness lenses

2)Ergonomic Optimization:

- Postural realignment every 5 minutes
- Cervical support braces
- Adjustable workstation configurations

3)Environmental Safety:

- 2×2m clear activity zones
- Spotter-assisted ambulation
- Emergency stop buttons

Should any discomfort emerge:

1)Immediately discontinue session.

2)Notify research staff (on-site medical team available).

3)Comprehensive assessment within 30 minutes.

Tailored intervention per symptom profile:

1)Vestibular symptoms: Vestibular-Ocular Reflex retraining.

2)Musculoskeletal pain: Physical therapy consultation.

3)Visual fatigue: Scheiman’ s 20-20-20 rule implementation.

All incidents trigger protocol review by the Data Safety Monitoring Board within 2 hours.

Potential Benefits of Participation

As a research participant, you will receive:

1.Comprehensive clinical assessments by senior rehabilitation specialists (Attending or Associate Chief Physicians) at no cost;

2.Evidence-based therapy sessions delivered by licensed physical therapists with ⩾5 years of stroke rehabilitation expertise;

3.Potential improvement in upper limb motor function based on prior clinical trial outcomes;

4.Full structural and functional MRI scans,including specialized neuroplasticity analysis;

5.Personalized rehabilitation progress reports with quantified functional gain metrics.

Financial & Confidentiality Provisions

Participation involves no financial obligations—all research-related procedures, assessments, and interventions are fully funded by the Ningxia Key R&D Program.

1.Regarding confidentiality:

1)Personal health information will be securely stored at the research facility under encrypted

digital archiving .

2)De-identification protocols assign unique participant codes (e.g., VR-GMI-057) replacing names in all research documents.

2.Authorized access is strictly limited to:

1)Principal Investigators.

2)Ethics Committee auditors.

3)Regulatory authorities for quality assurance.

4)Published results contain only aggregated data, with individual identities protected through k-anonymization.

Voluntary Participation Rights

Your involvement in this study is entirely voluntary. You retain the unconditional right to:

1.Decline participation prior to enrollment

2.Withdraw at any point during the study without penalty or impact on your standard medical care.

3.While we strongly encourage committed participation to maintain research integrity (withdrawal may compromise statistical validity), your clinical care will never be affected by participation decisions. Should you consider withdrawal:

1)Discuss concerns immediately with your research coordinator.

2)Receive comprehensive exit counseling.

3)Obtain all collected health data per GDPR Article 20.

4)Qualify for post-withdrawal follow-up assessments.

Additional Information & Next Steps

For study-related inquiries, 24/7 access is provided through:

1)Research Hotline: +86-951-6743730 (Principal Investigator Dr. Wen)

2)Dedicated Email: 872061529@qq.com

3)On-site Consultation: Room 201, Rehabilitation Building

Your current action options:

1)Seek Clarification: Discuss concerns with research coordinators using our Q&A checklist.

2)Decision Period: Take 3-7 days to review materials with family/physicians.

3)Document Retention: Preserve this document for future reference.

Enrollment Process: Upon decision to participate, notify screening staff for:

1)Immediate consent verification

2)Biometric ID registration

3)First assessment scheduling

Note: Research assistants will coordinate all logistical arrangements including transportation reimbursement and appointment reminders via WeChat/SMS.

Participant Rights Protection Statement

For inquiries regarding participant rights, welfare concerns, study-related grievances, or protocol recommendations, contact the Institutional Human Research Ethics Committee (HREC) at Ningxia

Medical University General Hospital:

Tel: +86-951-6744028 (Business Hours: Mon-Fri 8:30-17:00)

Subject Declaration

"I have read the information about this study and fully understand the potential risks and benefits of participation. I voluntarily agree to participate in this clinical trial.

☑ I consent / ☐ I decline to the use of my research data for studies unrelated to this primary research protocol."

Subject Signature

Signature

Printed Name: _____

Date: _____ Year _____ Month _____ Day

Contact Information:

Tel: _____

Email: _____

(Optional)

Investigator Declaration

"I confirm that I have explained the trial details to the subject, including their rights, potential benefits, and risks, and have provided a countersigned copy of this informed consent document."

Investigator Signature

Signature

Printed Name: Dr. _____

Date: _____ Year _____ Month _____ Day

Work Contact:

Tel: _____

Available Mon-Fri 8:30-17:00

MRI Procedure Informed Consent Document

Grant Project: Clinical Efficacy of Virtual Reality Technology Based on Mirror Neuron System Theory for Upper Limb Rehabilitation in Stroke Patients

Subject: **MRI Examination Protocol Consent**

MRI Safety Overview

We appreciate your contribution to this scientific study investigating novel VR-based mirror neuron therapies for stroke rehabilitation. Magnetic Resonance Imaging (MRI)—a non-invasive medical imaging technique developed in the 1990s—utilizes magnetic fields to visualize anatomical structures. This procedure:

✓ Involves NO radiation exposure

✓ Requires NO radioactive isotopes

✓ Needs NO pharmaceutical administration

✓ Maintains an exceptional safety profile with zero documented adverse events directly attributable to clinical MRI since its inception.

Pre-Scan Safety Screening

Before entering the MRI suite, confirm:

☐ **Presence of metal objects (keys, watches, etc.)**

☐ **Magnetic items (credit cards, electronic devices)**

☐ **Metallic accessories (jewelry, hairpins)**

☐ **Clothing with metal components (zippers, buckles)**

☐ **Surgical history: _____**

☐ **Potential internal metallic objects:**

- ☐Dental prosthetics/orthodontics
- ☐Orthopedic fixation plates
- ☐Aneurysm clips
- ☐Shrapnel
- ☐IUDs

☐ Implanted medical devices:

- ☐Cardiac pacemaker
- ☐Neurostimulator
- ☐Cochlear implant

(Non-removable metallic items may preclude MRI participation)

Research Team Commitments

Data Usage: All acquired data exclusively for scientific research; no commercial or media applications

Confidentiality: Rigorous protection of personal information per PIPL Article 18

Transparency: Full disclosure of procedural requirements and precautions

Data Access:

1)DICOM raw data available via secure portal upon request.

2)Physical films not routinely provided.

Incidental Findings: Free neuro-radiological consultation for clinically significant anomalies (no diagnostic/therapeutic follow-up).

Participant Responsibilities

By signing, you affirm:

1)Voluntary participation with accurate health information disclosure.

2)Compliance with all experimental requirements.

3)Transfer of all research data ownership to the institution.

Participant Rights:

1)Complimentary MRI scanning

2)Right to terminate scanning at any discomfort

3)Clarification of procedures upon request

4)Access to personal anatomical brain images (digital format)

5)Provision of feedback regarding procedural concerns

Consent Execution

Participant Declaration

"**I have reviewed this document and consent to participate**."

Signature: _____

Printed Name: _____

Investigator Attestation

"**I confirm protocol explanation and obligation fulfillment**."

Signature: _____

Printed Name: Dr. _____

Date: _____ Day of _____, 20